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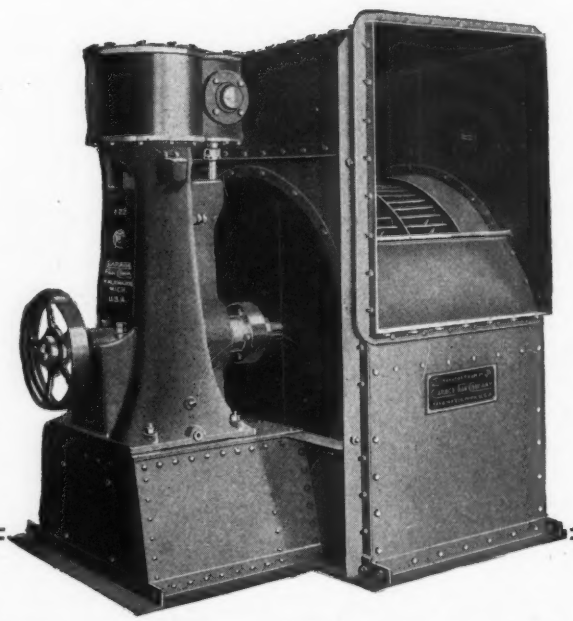

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. August, 1918 1123 Broadway, New York

A Study of Degrees of Discomfort

Based on Temperature Comfort Tests Made at the Chicago Normal College by Professor J. W. Shepherd.

During the intense hot spell last summer the *New York World* published the following inquiry on its editorial page:

"Showers that reduce the temperature and increase the humidity maintain the same average discomfort. Can not a method of registering heat and humidity be devised by which their combined devilishness can be indicated by one figure?"

This brings up an intricate subject, but one in which there is considerable popular interest; the average man does not know whether 88° and 40% humidity is more comfortable than 85° and 80% humidity, and indeed few engineers perfectly familiar with the relation between humidity and temperature would be able to answer this offhand. The word "humidity," of course, means moisture in the air and is usually expressed either as "absolute" humidity (the weight in grains of the water contained in 1 cu. ft. of air in the form of vapor) or as "relative" humidity (the percent of water contained in the air based on what the air could contain when saturated). "Relative" humidity is what is commonly meant when simply "humidity" is designated. How increased humidity makes us feel hot and uncomfortable is well known, but the exact relation can only be determined by the "feelings" of the average individual.

Nevertheless such a relation does exist and while its derivation is, perhaps, somewhat complex, the results can be tabulated into an easily comprehensible form. The entire relationship, depending on the average person's feelings, was tested and registered in a most thorough manner by Prof. J. W. Shepherd in the experimental room of the Chicago Normal College during 1912; these tests extended over a period of three months and involved many experiments on a large number of people. Dr. E. Vernon Hill, of the Chicago Department of Health, plotted the results on a chart and developed a formula which shows what humidity would be considered as ideally comfortable by the average person at any given temperature between 54° and 79° F. The formula deduced from the experiments is that

$$H = 100 - 4\ (T - 54) \text{ or}$$
$$H = 316 - 4\ T$$

When H = the relative humidity and
T = any temperature between 54 and 79° F.

This formula can be solved for either H or T if the other is assumed.

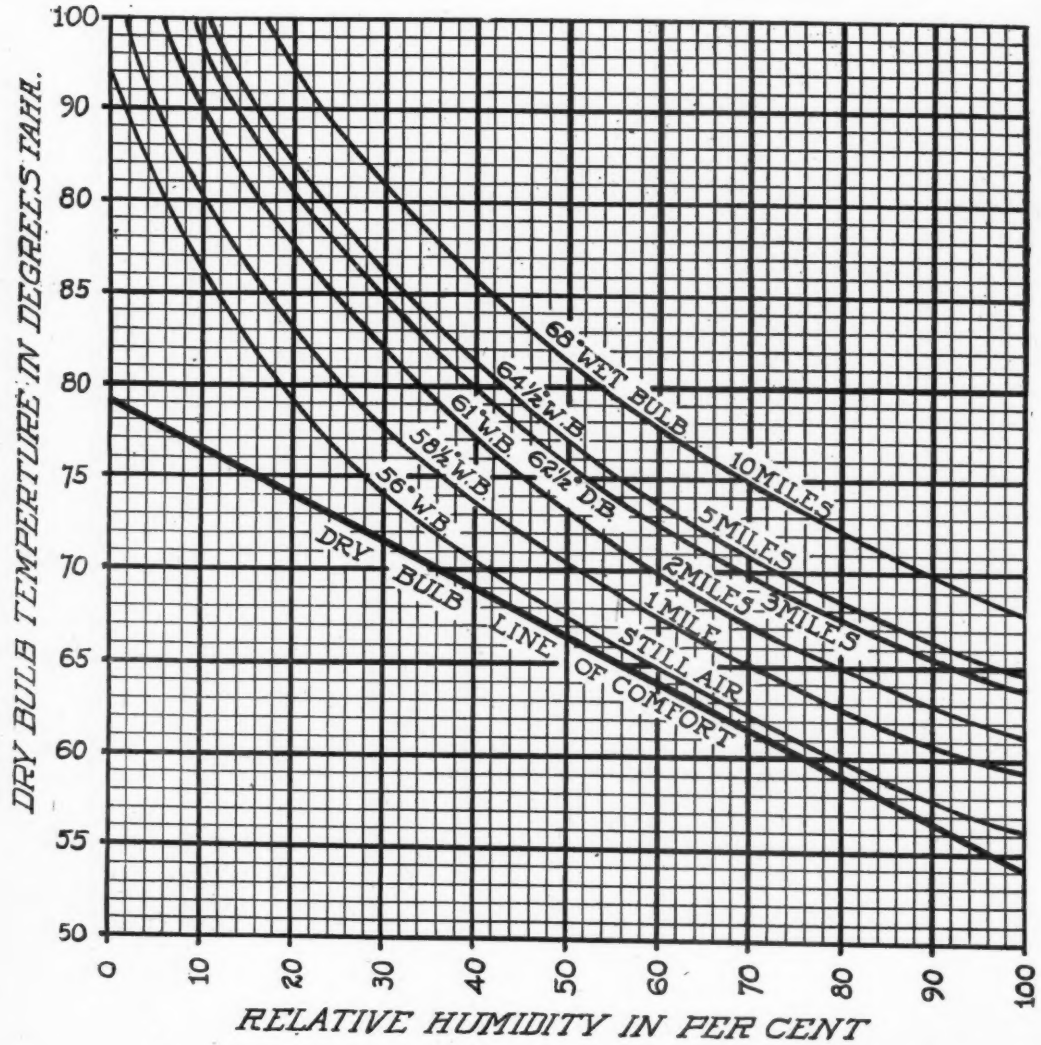
Thus at 70° temperature, the desirable humidity is 36%, while at 65° we can

stand 56% humidity with equal comfort.

A careful inspection of this chart and a little experimenting with the formula shows that with the increase of 1° of temperature or of 4% humidity the discomfort is equal. To apply this to the matter of temperatures above 79° or below 54° it is only necessary to take the humidity reading obtained at the time in question, find the temperature which will give absolute comfort with that amount of humidity and subtract this temperature from that actually obtained, thus obtaining the number of Fahrenheit degrees above the comfortable point under those conditions, or, in other words, the number of degrees of discomfort.

The most comfortable temperature based on the above formula for any percentage of humidity is as follows:

Relative Humidity Per Cent.	Comfortable Temperature, Degrees Fahr.
0	79
4	78
8	77
12	76
16	75
20	74
24	73
28	72
32	71



"DEGREE OF DISCOMFORT" CHART.

Relative Humidity Per Cent.	Comfortable Temperature Degrees Fahr.
36	70
40	69
44	68
48	67
52	66
56	65
60	64
64	63
68	62
72	61
76	60
80	59
84	58
88	57
92	56
96	55
100	54

Under ordinary conditions the outside humidity usually ranges from 50% to 80% and supposing a temperature of 90° is recorded with 60% humidity it is plain that the ideal temperature at 60% humidity is 64° F. and the degrees of discomfort are therefore 90 — 64, or 26°; whereas if 87° were recorded with 80% humidity the ideal temperature under the 80% would be 59° and the 87° (actual) — 59° (ideal) would be 28° of discomfort.

This difference should be known as "degrees of discomfort" and should furnish a reliable basis of comparison.

To check this it is only necessary to remember that 4% increase in humidity is equal to 1° rise in temperature. Thus the 87° and 80% humidity is a 20% increase in humidity over 90° and 60% or is equivalent to a temperature of

$$87 + \frac{20}{4} = 87 + 5 \text{ or } 92°$$

showing 2° increase in discomfort, which checks exactly with the result given.

It is becoming, however, a more and more recognized fact that with outside air conditions a breeze of greater or less intensity is quite likely to be encountered. Under such conditions an allowance must be made for the air movement and some other method used, either to modify the result obtained by the method just explained, or an entirely different basis of comparison used.

Investigations along this line have demonstrated in a matter reasonably conclusive that under certain velocities of air movement, at a given dry bulb temperature, a person will be most comfortable when the wet bulb stands at a certain level.

Experiments by the same authorities already quoted show that for various velocities of air movement the wet bulb must be about as follows:

COMFORT RELATIONS

Velocity of Air (Miles per Hour)	Wet Bulb Temperature (Degrees F.
Still Air	56
1	58.5
2	61
3	62.5
4	63.5
5	64.5
6	65.5
7	66.
8	66.5
9	67.
10	68.

Having the proper wet bulb temperature for a given air velocity and dry bulb it is a simple matter to determine what percent of humidity must accompany this state since the relative humidity governs the depression of the wet bulb.

In Fig. 1 the dry bulb temperatures are plotted vertically and the relative humidity percentages horizontally. On this chart are laid out curves giving certain wet bulb temperatures, these curves covering the proper wet bulb readings for still air, air at 1 mile, 2 miles, 3 miles, 5 miles and 10 miles velocity.

Thus, for the example previously quoted with 90° and 60% humidity—still air—the proper humidity is read by following the 60% line up from the bottom toward the top until it intersects the "still air" line and then reading at

the left of the table the proper temperature—or about 65°. Therefore 90° — 65° = 25° excess or 25 "degrees of discomfort." And for 87° and 80% relative humidity the proper temperature should be 60° thus giving 87° — 60° = 27° of discomfort which results closely approximate those obtained by the first method. If a 2-mile wind had been blowing on the day with 87° and 80%, however, the proper temperature read from the "two-mile" curve would then have been 65° and the degrees of discomfort 87° — 65° or 22°, showing that a slight breeze would render the 87° day more endurable.

On Fig. 1 the straight diagonal line has been laid in to show the relation between the results obtained by the first method and the curves obtained by the second method, together with the allowances for wind velocity.

Development in Heating and Ventilation During the Past Five Decades

In a review of the advances made in the art of heating and ventilation, contributed by Werner Nygren, C. E., to *Record and Guide,* Mr. Nygren says, among other things:

Air is the oldest of the three mediums used as heat carriers. Before water and steam were even thought of for this purpose, hot air or furnace heat was introduced and distributed in about the same manner as is done with the furnace-heating systems of the present time.

In the natural order of things, the first steam and water heating systems were of a home-made order. At the outset or pioneer period of the modern heating, there was not only the lack of the present-day knowledge gained by experience, but also the uncertainty of what material was best suited for pipes, heaters and boilers. The piping used was mostly made up of a hub-jointed cast-iron pipe, with caulked joints, assembled in about the same manner as our present cast-iron drain piping. Radiating surface was also made up in this manner and the boilers were either made specially for each installation according to the designer's own notion or else such available types of boilers as were then in use for operating steam engines were selected for this duty.

One of the earliest improvements was the introduction of the wrought-iron pipe assembled by screw joints and flanges and the use of wrought-iron pipe coils. A further step towards refinement was made by the invention of the radiator, which first made its appearance in the early fifties. Quite unlike most other innovations, the radiator in its earlier form was so efficient that but a very slight increase has been possible in all these years.

Indirect heating, like the direct method, was first accomplished with pipe coils. Indirect radiators made of cast-iron came into use about 1860. The original pattern, known as the "pin" pattern indirect radiator, is still being manufactured and used in competition with numerous other types of more recent design.

SECTIONAL CAST-IRON BOILERS FIRST MADE ABOUT 1850.

The first sectional cast-iron boiler of the type at present used for steam and hot water heating was made about 1850, but did not come into general use until in the early sixties. This has no reference to the power boilers of the sectional water-tube type which were con-

ceived prior to the year 1800, but were not widely used until some time later and were of but little merit until in the sixties, when they began to develop along the lines of their present-day form.

LITTLE CHANGE BETWEEN 1860 AND 1888.

During the time that elapsed between the introduction of radiators, sectional boilers and other specialties which gave the steam heat its present character and until about 1888 the demand for this form of heat was greatly increased without any noteworthy changes in its application except that exhaust steam more and more came into use. At the end of this period, however, something happened which gave steam heating new impetus and added prestige, viz., the invention of automatic heat control and the introduction of specialties for vacuum heating a few years later.

THE ADVANCE OF VACUUM HEATING

Vacuum heating, which first appeared in the early nineties, came very rapidly into use in steam-heated buildings, equipped with power plants, because it provided an effective method for distributing the exhaust steam for heating without undue back pressure on engines, pumps, etc.

While the basic patents of the system remained in force, the appliances used in connection therewith were sold to the trade together with licenses for operation of the systems in the buildings for which they were bought. Lately, and since these patents have expired, the appliances are sold without any operating rights and incidentally with greater competition and much less claim for economy in operation than formerly was the case. This is not intended to imply that the use of vacuum as an agency for induced steam circulation that reduces back pressure is not fraught with a certain economy or that this economy has been reduced by the influence of competition. On the contrary, the latest appliances of the older systems now in existence are more efficient than ever.

RETURN LINE AND AIR LINE SYSTEMS.

From the very beginning there have been two types of vacuum systems in use. One of these systems, known as the return-line system, is used very extensively at the present time. The function of this system is to expel both air and water of condensation through an automatic return valve attached to the outlet of each radiator and heat source of the heating apparatus. This valve discriminates between the steam which is to be retained and the water and air which are to be expelled. In this system the entire return piping is under suction from a pump which maintains a vacuum as needed and pumps the condensation water and air to a separating tank, whence the water is then returned for boiler feed. A modification of the vacuum return-line system is what is commonly known as the open return-line system, which differs principally in that the water of condensation and the air with it are discharged by gravity directly to the separating tank, the vacuum pump being omitted.

The other vacuum system, which also is in use at present, is known as the air-line vacuum system. The function of this system is to expel air from each radiator and heat source served by the heating system through an automatic air valve which discriminates between steam and air. The vacuum, which in this system is confined only to the air lines, was first produced by a steam ejector discharging the air to the atmosphere. Lately, however, this system is as frequently operated by vacuum pump as ejector. The air-line vacuum system is best suited for one-pipe heating systems, although it is occasionally used also in connection with two-pipe

systems. The vacuum return-line system, however, is only applied in connection with two-pipe systems.

MECHANICAL VENTILATION OF BUILDINGS A COMPARATIVELY RECENT DEVELOPMENT.

Little was done towards the application of mechanical ventilating until recent years, although it appears from old records that ventilating fans of crude form were in use more than 250 years ago for ventilating mines. Up to about 1870 fans were used mainly for special industrial processes and, with few exceptions, the ventilation of buildings as we know it today was either ignored or made to depend upon natural air movement secured by physicial properties of the atmosphere.

When consideration was first directed to the application of mechanical means of ventilation, the largest and most prominent places of assembly naturally received the first attention. To begin with, however, the use of mechanical devices was usually an afterthought and resorted to after the buildings were completed and when it had been found by bitter experience that the more primitive method of ventilating by heated shafts and chimneys could not produce satisfactory atmospheric conditions.

The House of Commons in England affords one of the earliest European examples of this kind. After many attempted improvements of the ventilation of this building the idea of moving the air by mechanical means was finally conceived in 1736 and a centrifugal fan was installed, which remained in service until 1820.

Another and more recent case was the U. S. Custom House in Boston. Bids for mechanical ventilating apparatus for this building were advertised for in 1846 after the building had been erected. The apparatus then installed incorporated a steam-driven fan, which was, perhaps, the first of its kind in this country.

The next fan installation appears to have been that in the Utica, N. Y., Insane Asylum. After this mechanical ventilating apparatus came into use more rapidly, until the present stage of development has been reached.

Fans of the present type did not come into general use until in the seventies when the self-contained steel-encased fan was put on the market for ventilating purposes. The introduction of this type fan, together with the development of the steam-tempering coil and the improved method of operating ventilating fans with steam engines driving directly on the fan shafts, gave the fan practice a new character. In later years electric motors have gradually taken the lead over steam engines for the operation of ventilating fans, on account of their greater convenience in operation and attendance and because motors lend themselves more readily for installations in out-of-way places than steam engines, besides which they can be made to operate practically without any noise or vibration, which is usually essential in ventilating work.

In our modern buildings space conditions must be carefully considered and conserved in order to find room for all the appliances and machinery that goes to make up the mechanical equipment. This situation has crowded out the cone fan as a supply blower in favor of its own offspring, the steel-encased centrifugal fan. For the same reason it has also been superseded as an exhaust fan by fans of more suitable types.

For exhausting air, both the so-called disc (or propeller) fan and the centrifugal fan are used. The former has gradually gained in favor on account of the comparatively little power this fan uses when handling air at low velocities as is the case with most of the present-day exhaust systems. It also offers less hindrance to the escape of the air by natural draft when not operated; a valuable feature in exhaust systems terminating at the roof, which is the case in most installations.

The origin of the principle on which the disc fan is founded dates back to

the time of the ancient Archimedes screw. At the present time there are several forms of disc fans which are variously used for exhausting air, for producing air currents, for fanning effect and as local ventilators set in the wall openings. The disc type fan is, however, but very seldom used as a blower fan inasmuch as it is incapable of creating the higher pressures usually encountered in air-supply systems.

DEVELOPMENT OF MULTIBLADE FANS

The blast wheel of the original steel-encased centrifugal fan was of the paddle-wheel type. The more compact "multi-blade" type of fan wheel which came into use in 1908, made the fan housing less bulky, an advantage that was quickly appreciated and soon made this newer type fan very popular.

Apart from the various other improvements that have been made from time to time, the following new features might be mentioned: The cooling of indoor atmosphere by refrigeration, well water and water spray; the introduction of the air washer for cleansing the air and the invention of the steam humidifier and the automatic control of both temperature and humidity.

CHEESE CLOTH SCREENS AND AIR WASHERS.

The old method of filtering air through cheese cloth is still in use for screening out dust and other mechanical impurities. The common practice about thirty years ago was to make up this filtering medium in form of bags, but the more modern method is to stretch the cheese cloth on vertical frames set in V-shaped holders, thus securing the requisite filter area in a more compact form.

The air washer as applied to ventilation work came into use about 1900. The steam humidifier, together with the automatic humidity control by the humidostat, appeared two or three years before. The steam humidifiers now in use are of two types, one causing the evaporation of water from a pan placed in the air passage by means of a steam coil in the water and the other releasing low-pressure steam directly to the air through perforated nozzles covered with lamp wick material.

MASONRY AIR DUCTS

The old method of conducting air for ventilation through masonry ducts and flues formed in the building construction is but seldom resorted to at present. Ducts and flues made of galvanized iron are instead used for this purpose because of their greater efficiency due to decreased friction, decreased air leakage and increased cleanliness.

PIPE COVERINGS.

The precautions which had to be taken against undue heat losses and disagreeable effects from the hot pipes, flues, etc., have brought into use various forms of non-conducting covering. Among the first materials used for this purpose was hair felt, a covering material which consisted of cow's hair and which, when carefully applied, provided a very efficient nonconductor. It was found, however, to have one very serious defect,—i. e., under the action of heat vermin bred rapidly in this material. Its use as an insulating material for hot surfaces is therefore now limited mostly to temporary covering of pipes during building construction operations. The modern covering both for pipes and other hot surfaces is mostly made of mineral substances, such as asbestos, magnesia, diatomaceous earth, etc. Covering for pipes and fittings is made up in sectional form and canvas jacketed whereas covering for other purposes is usually made in blocks or sheets for convenient application and either finished off with plastic cement or encased in canvas, glued or sewed on.

The matter of non-conducting cover-

ing is given very careful consideration in present-day practice, as it is realized that proper protection in this respect has an important bearing not only on the economy of operation of heating and ventilating apparatus, but also on the results to be accomplished.

SLOW DEVELOPMENT OF SCIENCE OF HEATING.

From the scientific aspect a great deal of valuable information has been gathered during the evolution of the heating and ventilating practice. The science on this subject did not develop very rapidly, however. Its path was beset with conflicting theories and whims which had to be eliminated before data of scientific and practical character would be accepted. Some very simple facts and theories were literally dragged forth from obscurity by repeated failures in obtaining uniform results, because of the fact that physical laws had been overlooked.

A striking example of this is the old method of sizing radiators on the cubic foot basis. For a very long time the simple and obvious theory that the heat requirements of a room are in direct proportion to the room exposure was lost sight of, and until this theory was applied it was customary to allot heat in direct proportion to the cubic contents with an arbitrary allowance for extra severe conditions. This method occasionally and repeatedly resulted in huge failures, but is still used to some extent.

Meeting the High Cost of Heating and Ventilating Apparatus

A Discussion Based upon an Article in the March, 1918, Issue, Advocating the Use of Pipe Coils as an Economy Measure.

By GEORGE T. MOTT.

In the study or application of heating equipment, a reduction in cost of installation without injury to the successful plant condition, is to be commended. This question, therefore, is one which exihibits an interest not only in the welfare of the trade, but also in that of the investor.

The development of heating equipment of all kinds, and this can embrace every functioning device, whether a radiator, boiler, fan, motor or valve, has been developed not only commercially but scientifically with a view to its capacity of output, its economy of operation, its stability and its initial cost. These features are of necessity synonymous with progress, and progress, in a sense, is synonymous with commercial success.

To revert, as was proposed by a writer in THE HEATING AND VENTILATING MAGAZINE for March, to a type of heating equipment (pipe coils), at its zenith of popularity perhaps 25 years ago, does not apparently imply a very high order of faith or confidence in the development of radiating surfaces during the intervening period.

LARGE GLASS AREAS LEAVE LIMITED SPACE FOR HEATING SURFACES

The large glass areas required by law for school work and, by the law of economy, for other classes of building, provide but limited areas for the installation of heating surface. This large glass area is also a potent factor in the quantity of heating surface re-

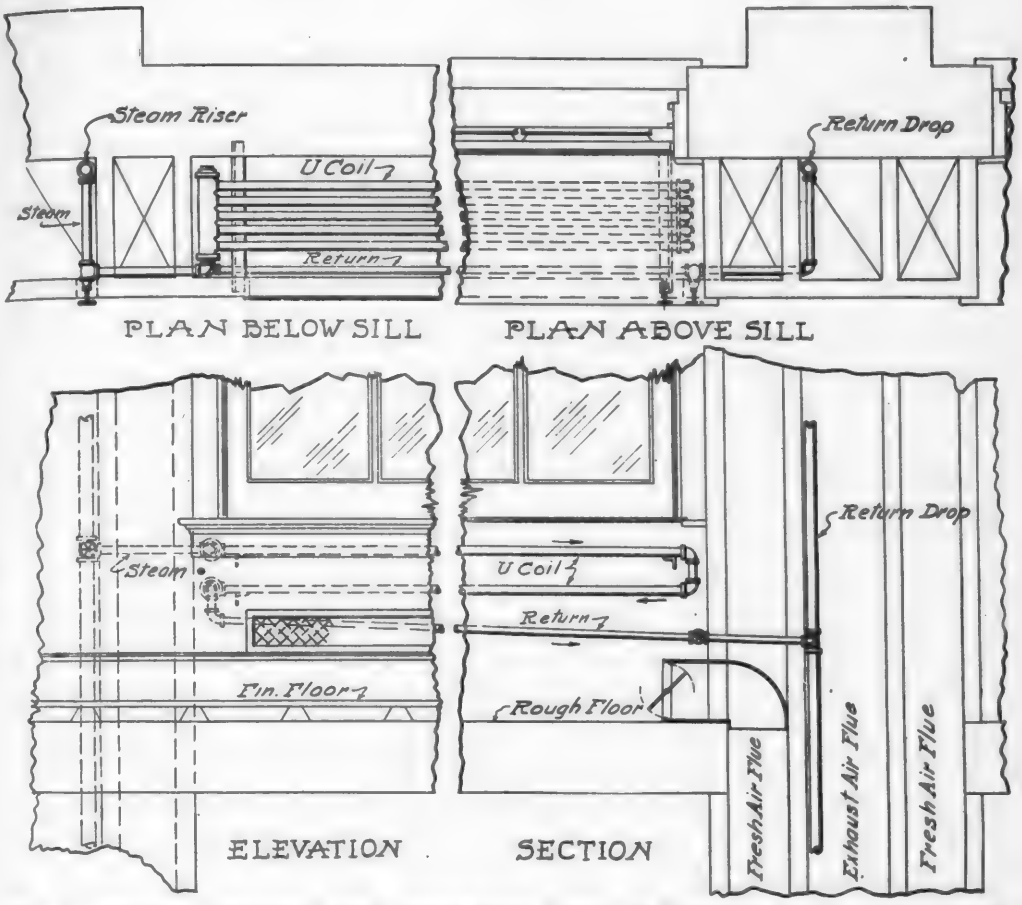


FIG. 1.—SCHEME PROPOSED FOR USING PIPE COILS IN HEATING SCHOOL BUILDINGS.

quired, so that the four or six-pipe 1-in., 1¼-in., or 1½-in. pipe coil, as previously used, no longer meets the requirements.

The item of space condition, always a factor to be dealt with, is not one easily met by the pipe-coil proposition. The suggested coils illustrated in the article referred to, would not meet the stated requirements. In any event, the scheme outlined, in which coils are placed underneath the window-sill, in the path of an air supply, would require a recessed space beneath the window to enable the coil and ducts to be properly enclosed.

In the smaller school, in which this type of installation would only be applicable, there is little opportunity to provide sufficient recess depth to install the necessary flue and coil surface and there are few, if any, communities which provide schoolrooms of such dimensions as to make it permissible to take up so much space from the schoolroom. In most instances, the municipal or State ordinances prohibit the extension of such projections into the aisle beyond a very limited degree, in consequence of which it is necessary, in providing sufficient heating surface for any particular building of modern construction, to use a type of surface of materially greater compactness than pipe coils. If this surface so substituted for the pipe coil, should be of equal or greater thermal transmission value, and be easier to handle and erect, and if the first cost of this product should not exceed that of the pipe coil, the problem would be solved by a process of elimination.

WALL RADIATION AS A SUBSTITUTE FOR PIPE COILS

It is presumed, from the comparative B. T. U. figures given in the article under discussion of 300 versus 250, that the cast-iron radiation referred to is of the type generally known as column radiation. This being the case and for comparison with, say, a five or six-pipe 1-in. or 1¼-in. pipe coil, the ratios would be absolutely correct. The use of wall radiation, however, in this connection, seems not to have been considered.

As far as the efficiency of wall radiation is concerned, it has been shown in successive series of tests made periodically and covering many years, that the efficiency of a wall radiator of approved type is equal, in every respect, to that of a pipe coil, and, as a matter of fact, in many instances and circumstances, it has been found to exceed the pipe coil. In the writer's experience, it has usually and more frequently been found possible to reduce the amount of surface specified when using wall radiation below that of the pipe-coil surface. When comparisons are drawn, between the transmission value of wall radiation as against the box coil and under gravity conditions, the wall radiator exhibits a marked superiority over the pipe coil, running as high as 30%. This is generally due to the increased convective value of the wall radiator.

HIGH COST OF PIPE AND LABOR A FACTOR

Another point to be considered in discussing the economy of pipe-coil surface is that the material for pipe-coil construction of today, is excessively high, and both pipe and labor are almost equally scarce, in consequence of which both of these features carry a premium which does not occur in the construction of wall radiation. An enormous shrinkage in the quantity of small-pipe on the market and the urgent need for pipe in our industrials and for ship building would seem to carry with it a demand to use cast-iron surface wherever possible, if only as a patriotic measure. But where these measures involve also a greater economy, the answer seems imperative.

Actual current installation costs, based on a comparison between pipe coil and wall radiation, using, in the first instance, a six-pipe 1¼-in. coil, approximately 100 ft. in length (which is the most favorable pipe coil which it is possible to construct from a cost point of view and based on the low market quotation applicable to carload lots), compared with a well-known make of wall radiation at the recent advance and at sheet, shows a reduction in the cost of erected wall radiator units in excess of 1 and ½ cents per square foot. Moreover, it is obvious that the cost of handling and erecting wall radiation will be far below that of the labor expended in the building and erecting of pipe coils.

Where the features of relative appearance and stability are increased and where the depreciation and repairs are correspondingly decreased, and where the wall radiation lends itself so admirably to the space conditions permissible in the newer type of buildings, it would appear that the aggregate benefits to be derived from the installations of this surface, over the old-time pipe coil, were manifold. It is also true that the several features and conditions outlined in the article in question, for general reduction in the cost, relating to arrangement and connections, valves, etc., are equally applicable in every respect to wall radiation, and the type of plant selection is equally optional.

It would further seem, in comparing the sketches with the current practice of installing direct-heating surface in a classroom, providing for such thermal losses as occur in a building, that it would not be a matter of economy to install an amount of surface which would be employed only in raising a given volume of air through a temperature range of 10° when the installation

of direct wall radiation would be capable of offsetting the thermal losses referred to, by the delivery of air under gravitation through a temperature increase of from 35° to 40°. It would further seem that no economy would result with such a scheme as proposed since no provision has been made for heating during the early morning period when it is necessary to bring the school up to a living temperature when not occupied. It is obvious that if this coil surface is so installed as to give increased temperature range of but 10% under the velocity due to the fan action, its operation during the early morning hours under gravitation would be, to all intents and purposes, relatively negligible. This would argue the necessity of operating the plenum system not only during the period of occupancy but also during that period of time previous when the warming of the building to a livable temperature was being accomplished.

Therefore, as the scheme suggested does not provide the flexibility necessary to cover the several conditions of operation implied and as first cost appears to be the only point of consideration, it might be suggested that the idea be carried a step further by having the direct surface, so called, entirely eliminated, and the entire equipment grouped into a single plenum chamber.

It is a matter of questionable economy, to substitute brick for sheet metal flues, not only as to first cost, but also as to space conditions, as it is obvious that a galvanized flue of dimensions corresponding to those of a brick flue occupies naturally less space, and this space economy does not appear to be incorporated in the proposed scheme, where the group of several flues in brick would occupy practically the same amount of space required by the larger galvanized flue.

ANALYSIS OF PROPOSED SCHEME

An analysis of the proposed scheme would appear as follows, basing our calculations, on a small school, and making no provision for an auditorium, halls, or other adjuncts, and accepting, in each instance, 40-pupil classrooms on the usual 30 cu. ft. basis and assuming that the entire quantity of air delivered to each classroom shall pass through two successive temperature steps and through a total range, at zero, from zero to 100°, and successively through the surface installed directly in the classroom, from 100° to 115° (the 70° figure quoted in the article as the final temperature of air delivered to the classroom being insufficient to maintain 70° in zero weather) and assuming, further, that the particular classroom under analysis shall contain three of these discharge units.

We then have the elements appearing as follows, and to preserve the parallel in the comparative figures given in the article, we shall, although it is rather high, accept the 400 ft. velocity indicated at the register face and tentatively specified for delivery through the coil surface suggested.

Acting on this assumption, we find that each of the three units specified calls for 400 cu. ft. of air per minute, and, as the velocity specified is also 400 ft., this would require 1 sq. ft. of free area at the grill or delivery inlet to the classroom. As grills ordinarily interpose from 30% to 50% of equivalent frictional area to intercept the flow of air, the register openings must necessarily be increased in this proportion and to further conform to the suggestions given, it is assumed that the register openings will be increased 30% and will be 4-in. in width, which will give us, for three units as proposed, a length of 46.8-in. in each case and this may be assumed also to equal the length of the individual pipe, or the length of the coil in question.

The steam temperature implied, is evidently that corresponding approximately to 5 lbs. working pressure, or 227°, in consequence of which the transmission value of the pipe coil in ques-

tion, delivering air through a temperature range of from 100° to 115° would be approximately 418 B. T. U. per hour. On this basis, the total amount of coil surface required in each unit would be 15.6 sq. ft. and to maintain a free area of 1 sq. ft. as required making further provision for frictional resistance, and with the necessary depth of coil to carry through the temperature range implied, would require a coil six pipes in depth, giving a transmission factor of approximately 3.5, under fan control.

The effective value of this surface however, for heating during the early morning and noon-time periods, would be materially reduced, by reason of the necessity for operating under gravity for economic reasons, and due also to the enclosed condition of the surface, and is further accentuated by the low window seat enclosure. This reduction would be in value not less than 20%, and, unless carefully arranged, much greater, making effective but 80% of the actual surface. Under this condition, the co-efficient of transmission would be approximately 1.6 B. T. U.; less than that of full standing wall radiation.

Accepting the statement given in the original article, as to the requirement for thermal losses only of 130 sq. ft. of direct surface, and accepting also, the 250 B. T. U. assigned thereto, we find that for the three units proposed, consisting of 43.3 sq. ft., each approximately, we have an assumed total radiation value to offset the thermal losses only, of 10,825 B. T. U. As the coil surface in question contains in the total but 37.44 sq. ft. in effective surface, there is obviously a deficit for the early morning period, of approximately 70%. [With the coil surface only in operation and with an external temperature of zero, the internal temperature would not rise above 30°. It would seem from this, then, that the proposed proposition is not practical on the basis of the division as established, as it is evident that during the unoccupied periods it would require that the fan system be in operation 60% to 75% of the time as expressed in school-days, and much in excess of the requirements when operating under direct auxiliary operation, or, in other words, with free standing wall radiation.]

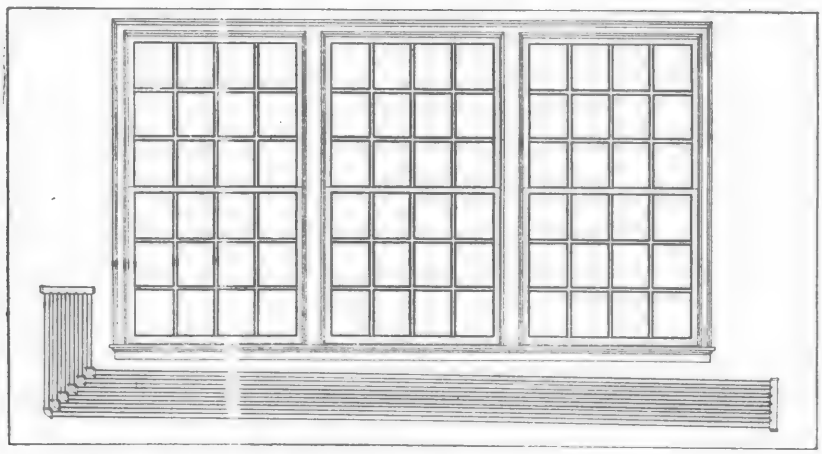


FIG. 2.—SPACE CONDITIONS WITH PIPE COILS.

Figs. 2 and 3 show respectively the space conditions as they exist in connection with free standing wall radiation and pipe coils with similar amounts of surface and show also, as compared with Fig. 1, from the article in question, the relative limited space occupied by

the wall radiation in relation to wall coils, and the very material consequent saving in floor areas.

The suggested ventilating equipment, as a part of the proposed scheme, will apparently also bear a careful analytical inspection. The pains-taking comparisons shown for the reduction of duct metal used would seem to indicate that the saving effected in this reduction, would be, in a ratio, in direct accord with this weight reduction. This, however, is far from being the case.

It is readily observable that the labor cost of building, say, an 8.5-in. x 8.5-in., a 7-in. x 7-in. or a 6-in. x 6-in. duct, as against that of, say a 12-in. x 12-in., is, for all practical purposes, eliminating the additional weight to be handled, exactly the same, and, while it is highly commendable to effect the saving shown in metal, this can only economically be accomplished where no other influence can be applied, that may in any degree offset this.

There is, however, in the delivery of air at high velocities, a frictional factor of very considerable import in the relation of high to low velocities. This is exemplified in the drafting room adage, "As loss of pressure varies as the square of the velocity, large ducts and consequent low velocities are most economical."

Let us, for comparison, assume a system handling, say, 7,250 cu. ft. free delivery, operating against a 0.2 oz. pressure. For the purpose of maintaining a low velocity we will designate a 90-in. steel-plate fan with a 54-in. wheel, delivering at a velocity of approximately 1160 ft. per minute.

For direct comparison with this condition it is now proposed that we double our velocities, and as the resistance varies as the square of the velocity, the operating pressure is now increased in this ratio to 0.8 oz. for this similar service. Under this condition, let us assign a 70-in. fan with a 42-in. wheel and delivering under the 0.8 oz. pressure, and free delivery 8760 cu. ft.; the velocity in question under this condition being 2190 ft. or practically double that of the fan previously noted, while the actual outlet delivery is practically the same.

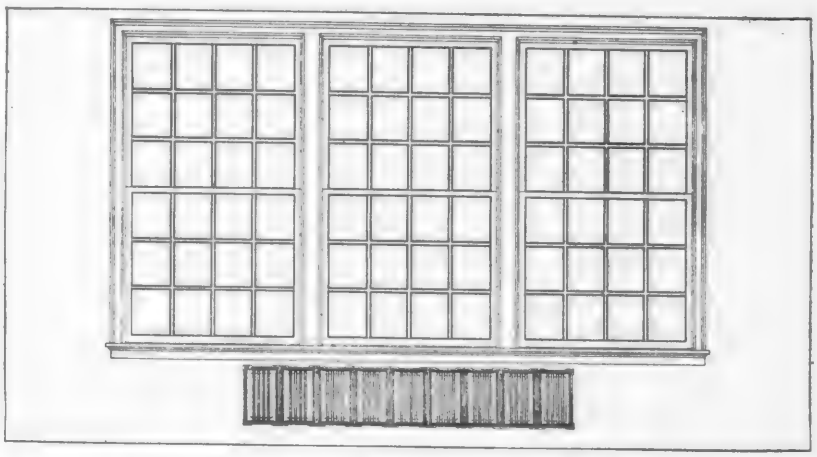


FIG. 3.—SPACE CONDITIONS WITH WALL RADIATION OF EQUAL CAPACITY.

The motive power required in each instance is for the 90-in. fan at 1000 ft. velocity, approximately 1.1 h. p., and, for the 2000 ft. velocity, 4.54 h. p.

Calculating, say, for a school proposition, on a 6-hour operating base per day, and for a working season of seven months, and on a basis of 6 cents and 5 cents per K. W., for the small and large motors, respectively, we have, in the first instance: under the 1000 ft.

velocity, a power operating cost per season of $53.10; in the second instance, under the 2000 ft. velocity, a power operating cost per season of $182.00, making the net increased cost for the higher velocity approximately $129.90. This on an investment basis of 5% would require a reduction in the initial cost of the equipment approximating $2600.00.

The proposed economy is evidently suggested on the basis of an advantage to be taken in the capacity of the coil surface installed in the classroom by reason of augmented transmission value, due to the direct delivery of the fresh air at a comparatively low temperature and high velocity immediately over and through same, and while this condition would obtain, and would also be equally true of any other surface, there is in the application of this to schoolrooms, a material handicap by reason of the absolute necessity for maintaining low velocities at the point of delivery, which velocities should not in fact exceed from 220 ft. to 300 ft., to say nothing of extremes in operating requirements at various periods.

It is possible, however, as shown, if desiring to put into effect a first-cost proposition, to obtain a materially increased transmission due to velocity, in the plenum chamber, and this would hold with any type of surface and is frequently done, but within limited ranges.

DIFFERENT SCHEMES SUMMARIZED

In conclusion then it would seem that the following schemes submit themselves in summary and are given in the order of cost, decreasing from No. 1 to No. 3, when combining first cost and operating charges, depreciation, etc.:

1. A plenum system with sufficient surface to heat from 0° to 100° under high velocities and with coil surface in the room sufficient to carry through an additional 15° range. This scheme involves a limited amount of plenum coil, an excess amount of coil surface for reheating when compared with the plenum coil, a small fan at high velocity, a large motor, limited control or flexibility, and a constant operation with high "overhead."

2. A plenum system with sufficient capacity to heat from 0° to 115°. As compared with scheme No. 1, this entails the elimination of reheating surface, a smaller amount of heating surface in the total, a fan of the same dimensions for high velocities, a motor of same dimensions, limited control difficult to maintain, and a constant operating "overhead" equal to No. 1, but with a marked reduction in first cost.

3. A plenum system of sufficient capacity to heat from 0° to 100°, with direct surface sufficient to offset the room thermal losses and entailing a low air velocity. With this scheme would be used hot blast surface of high transmission value and low resistance, wall radiation of high transmission value to offset room transmission losses, a greater amount of heating surface in the total for direct heating, a larger fan operating at a low velocity, a materially smaller motor, a thoroughly economic temperature flexibility, and a material reduction in "overhead" by reason of the gravity operation permissible during the time of unoccupancy.

To scheme No. 3 must be added, as shown, not only the advantage in control and flexibility to meet all periods of operation, but also the compactness due to the installation of the direct wall radiation.

It would appear further that the present working system of heating, as evolved through a long period of study and application and which embraces a combination of direct wall surface in conjunction with a plenum system, practically answers the question raised and justifies the adoption of this particular method of application from a point of economy.

Heating and Ventilating Equipment as Realty Fixtures

A Summary of Court decisions on the Removable Character of Such Appliances as Against Adverse Claimants.

By ARTHUR L. H. STREET.

The difficulty encountered in "Pigs is Pigs," in classifying guinea pigs under an express company's tariffs, was not greater than the difficulty the courts have found in the matter of determining the relation of heating appliances to the real estate upon which they have been installed.

Believing that readers of THE HEATING AND VENTILATING MAGAZINE will find a general survey of the more important of the reported cases on this subject interesting, because of the considerable importance of the questions involved, the writer will attempt in this article to show the trend of judicial authority on the right to remove appliances from premises on which they have been installed, including the right of a conditional seller to exercise a reservation of title as against a purchaser or mortgagee of the premises and the right of removal in other instances where one other than the owner of the premises claims an interest in heating and ventilating equipment.

It is well known that where a modern heating plant is built into a structure, and especially when it is done in the construction of the building, it is to be deemed just as much a part of the real estate as the doors and windows. From this it follows that, except as the seller may have perfected a mechanic's lien or have a mortgage upon the premises, as security for any sum due him, a mortgagee or purchaser of the real estate is ordinarily entitled to claim the plant as a part of the realty.

The cases which perplex the courts are those where heating plants are portable or semi-portable, as shown by the decisions referred to below.

In the case of Thielman vs. Carr, 75 Ill., 385, which was a suit to enforce a mechanic's lien against a building, it was objected that a furnace and pipes installed in connection with it could not be regarded as a part of the building. But the Illinois Supreme Court said:

"It is believed that ordinary stoves and pipes have been always conceded to be personalty or mere chattels. They, as all know, are not intended to become, and form a part of the building. But with furnaces it is different, as it is known that they are intended to be permanent, and a part of the structure. They are seldom, if ever, detached from the building, so long as they last, whilst stoves are frequently moved and again replaced. Another difference is, that furnaces cannot be removed without taking them apart, and the intent must usually control. If, as is believed to be generally true, furnaces are intended to be permanent, and to become a part of the building, that would stamp their character, and require them to be held realty. It would seem to be as much so as a steam engine in a mill or factory, and we are not aware, that when placed in the building by the owner, it has ever been doubted that it thereby becomes realty."

But the court notes that this holding must not be regarded as inconsistent with the right of a lessee of premises to reserve the privilege of removing a furnace installed by him.

A CASE WHERE BOILERS WERE INSTALLED BY CONTRACTOR, BUT NOT PAID FOR.

In the New York case of Jermyn vs. Hunter, 93 App. Div. 175, plaintiff sued to recover possession of two large

boilers and a hot-water heater which he had sold to a contractor for installation in a building, under agreement with the contractor that title should remain in plaintiff until payment of the price. Plaintiff knew that the equipment was to be installed in a permanent manner in a building not owned by the contractor, and the owners of the building had no knowledge as to the attempted reservation of title to the appliances. Under these circumstances, the Appellate Division of the Supreme Court decided that, as against the owners of the building and a purchaser of the premises at subsequent mortgage foreclosure sale, the heating apparatus became part of the real estate and hence was not recoverable by plaintiff, especially since the boilers had been bricked in, although they could have been removed without interfering with the main walls of the building.

The court found that the evidence showed the existence of the three conditions generally held by the courts as showing a permanent accession to real estate: (1) There was an actual annexation to the realty. (2) There was a purpose to use the boilers in connection with the realty. (3) There was intention by the owner to make them a permanent accession.

WHEN FIXTURES MAY REMAIN PERSONAL PROPERTY.

But the court said: "We do not overlook the fact that fixtures, annexed to real property in such form that they would pass as real property under a deed may, nevertheless, *by agreement between the owner and the person installing the fixtures, or the vendor of the same, continue* to remain personal property. * * * If vendors of personal property seek to make a conditional sale they should be required to deal with the owner of the property and not alone with the contractor without notice to the owner."

The opinion also refers to the Lien Law as affording sufficient security for sellers of chattels which enter into the construction of realty.

A furnace and boiler in a theatre building, resting upon a solid foundation and not removable without tearing away masonry, together with connecting pipes and radiators, were held by the Washington Supreme Court to have been real estate fixtures which passed to the purchaser under a mortgage foreclosure sale of the premises. (Filley vs. Christopher, 39 Wash. 22.)

And in Keeler vs. Keeler, 31 New Jersey Equity Reports, 181, it was held that steam pipes constituting part of a heating plant passed under a mortgage of the real estate, as against a prior chattel mortgage covering the pipes; they having been attached to a boiler, constituting a permanent fixture.

POSSIBLE INJURY TO BUILDING OFTEN A CONTROLLING FACTOR.

In the absence of other evidence on the question of intention to make a permanent installation of apparatus in a building, the fact whether or not removal can be effected without leaving the building in an injured condition is often controlling. But in the case of Newcastle Theatre Co. vs. Ward, 57 Ind. App. 473, it was decided that, in the absence of any showing of intent to make a permanent installation of a heating plant, the fact that holes would be left in floors where the steam pipes had passed through did not prevent a removal of the equipment as chattel property, the boiler not being attached to the real estate, except as it rested on the basement floor and was connected to the pipes, which were suspended from the joists of the building by hangers.

In the case of Stockwell vs. Campbell, 39 Conn. 362, it was declared, however, that although a hot-air furnace was not affixed to a building and was portable and held in place only by its own weight, the fact that a pit had been prepared for it, into which it

fitted, constituted it and the connecting pipes a part of the realty so that those who furnished the furnace could enforce a mechanic's lien for their claim.

In the latter case of Rahway Savings Institution vs. Irving Street Baptist Church, 36 N. J. Eq., 61, this decision of the Connecticut court was relied upon as authority for the proposition that a similar furnace resting on the cellar floor of a church building constitued part of the real estate, in favor of a mortgagee of the premises. But the New Jersey Court of Chancery distinguished the Connecticut decision on the ground that it was based upon a conclusion that intention to make annexation of the furnace permanent was shown by making the pit in the basement, adapted in size and depth and for the express purpose of receiving the furnace whereas in the New Jersey case, the furnace merely rested on the floor, replaced stoves and was not installed in such manner as to indicate permanence.

"Now, while it is true," said the New Jersey court, "that it is not necessary to constitute an article a fixture that it be actually fastened to the freehold or something accessory thereto, * * * it cannot be held that the mere fact that a chattel is placed in a part of the house which has been adapted to receive it, will make it a fixture; for example, a bedstead in a house obviously would not be made a fixture by the mere fact that it was placed in an alcove made to receive a bedstead. And so, too, the mere fact that a stove or portable furnace is placed in a niche made to receive it 'will not make such stove or furnace a fixture.'"

RADIATORS AS DETACHABLE PARTS

There are three interesting decisions in which the character of radiators as detachable parts of heating plants has been considered.

In J. L. Mott Iron Works vs. Middle States Loan, Building & Construction Co., 17 District of Columbia Appeal Cases, 584, the loan company unsuccessfully sued to the restrain the Mott company from reclaiming certain radiators and valves which had been installed under a conditional sale contract by the latter company on premises against which the loan company held a mortgage given before the appliances were installed.

The court briefly discussed the abstract proposition whether radiators should be likened to gas fixtures, which are held by the great weight of judicial authority to be ordinarily removable as retaining their character as chattel property. But the opinion expresses no decision upon this point. The court merely decides that a conditional sale of radiators will give the seller, under his reservation of title until payment, rights superior to a prior mortgage upon the real estate; and that articles installed upon real estate may be held subject to chattel mortgage, as against a prior mortgagee of the real estate, where the articles may be removed without injury to the real property. This decision rested, however, upon the grounds that the radiators could be readily detached without injury to the building and without diminishing any security to which the real estate mortgagee was entitled to resort under its mortgage.

PENNSYLVANIA COURT LIKENS RADIATORS TO GAS STOVES.

In the case of Bank vs. North, 160 Pa. St. Rep., 303, the Pennsylvania Supreme Court decided that radiators are to be regarded in the same light as gas stoves, with the same right to hold them in ownership severed from the title to the real estate, regardless of the character of the pipes to which they may be attached.

MINNESOTA SUPREME COURT RULES THAT RADIATORS ARE PART OF REALTY.

The doctrine of this case was expressly disapproved by the Minnesota

Supreme Court in the case of Capehart vs. Foster, 61 Minn., 132, where it was decided that radiators forming part of a steam heating plant must be regarded as part of the realty, in favor of a mortgagee of the premises, as against the owner.

"These radiators were put in immediately after the building was erected. There is no reason for holding that the owner did not intend them to be permanently annexed to the steam plant, and therefore permanently annexed to the realty. He might remove or change them, and so might he remove or change the boiler or the furnace, which is also a part of the same steam plant. Such radiators are an essential part of such plant, and are rarely furnished by tenants or temporary occupants of buildings as a part of the furniture brought with them or carried away with them, but the owner who furnishes the rest of such plant usually furnishes the radiators also. When, under ordinary circumstances, the owner of the building attaches such radiators to his steam plant, it should be held that he intended them to be permanently annexed to the realty. We are cited to National Bank vs. North, 160 Pa. St. 303, 28 Atl., 694, which holds to the contrary. This case holds that such radiators are analogous to gas fixtures, and therefore not a part of the realty. By following the same process of reasoning by analogy you would strip a house of all modern improvements, and by continuing that process you would overturn the greater part of the law of fixtures."

From what has been said it will be seen that it is quite impossible to lay down a set of hard and fast rules that can be followed safely in every State. But it is hoped that this discussion will serve to increase the exercise of caution by those who seek to retain chattel interests in equipment installed upon realty, by suggesting the advisability of taking legal advice concerning local laws and decisions before risking much on this form of security.

It is clear enough that, as between the immediate parties to a contract, equipment may take the form of real estate or remain chattel property according to their agreement, and that persons having notice of such agreement will be bound thereby, but particular pains must be taken to avoid the possibility of some third person acquiring rights in the real estate upon the apparent faith of the particular equipment being a part of the realty.

CHICAGO COMMISSION ON VENTILATION

School Building Heating and Ventilation

BY SAMUEL R. LEWIS.

School buildings are heated by direct methods, using stoves or steam or water radiators, placed in the rooms; and by indirect methods, under which the heaters, using furnaces or radiators, are placed outside of the rooms, warming air, which, displacing or mixing with the air in the rooms, maintains the necessary temperature.

When direct heating is adopted, the ventilation, when any is obtained, is arbitrary, usually according to the prejudices of the teacher, who manipulates the doors and windows. With stoves, the draft requirements of the fires cause a constant air change via the chimney, but not of sufficient volume to be classed as ventilation. Sometimes heated vent flues and jacketed stoves, using an air supply from outside, are provided, which give fairly good results when the temperature outside is below 40°F. This arrangement (Fig. 1), while very old, as the illustration indicates, is probably the most practical one known at

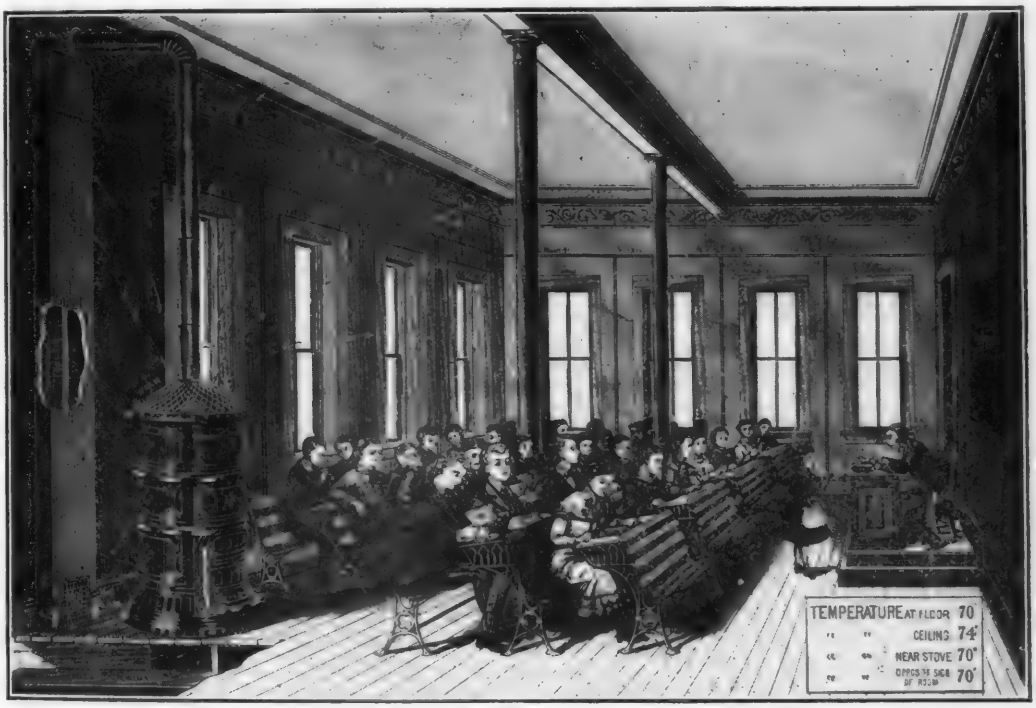


FIG. 1.

From a catalog published forty years ago. The vent flue is heated by the warm gases from the stove, and draws the air from the floor. Fresh air from outside replaces continuously the air removed. In all probability, there is considerably more variation in temperature than the illustration indicates.

present for one-room, rural schools. The worst condition as to ventilation obtains in school rooms heated with direct steam or hot water radiators, with closed windows.

A combination arrangement (Fig. 2), in which there are provided jacketed radiators, usually one for each class-room, and vent flues which are heated, comparable with the jacketed-stove scheme, is well known. Owing to the lower temperatures of the heating surface and the fact that the buildings may be heated by the direct radiators without opening the fresh-air supply windows to the indirect radiators, the combination arrangement is less effective than the jacketed stove, while subject to most of the short-comings of the latter. It is always difficult to control the temperature; the volume of fresh air handled increases as it gets colder outside; the heated chimneys are wasteful; the air distribution within the room is inefficient; and the system as a system will not operate to much advantage when it is warmer than freezing outside.

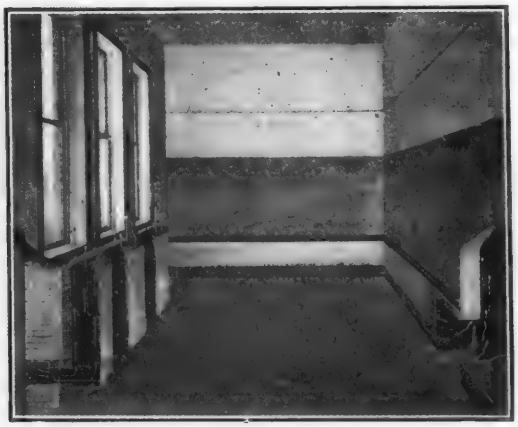


FIG. 2.

Section through a school-room showing direct-indirect steam heating and ventilation. The fresh air entering through openings under the windows, rises around the radiators, which have jackets, and finally leaves the room through the vent flue on the right, which flue, it will be seen, is heated by a radiator. Observations of such plants in operation show them to be profoundly affected by wind conditions, and therefore unreliable.

WHEN WINDOW VENTILATION IS PRACTICABLE.

With any method of direct heating, an expert, giving practically his undivided attention to the matter, may achieve fairly good ventilation by manipulating the windows. Careful tests of many window-ventilated buildings operated by the teachers under very consistent instruction and supervision, however, demonstrate the following:

Window ventilation for school rooms and for rooms in general, is practicable only—

A. When the walls and floors and furniture and occupants are warm.

B. When the room so ventilated happens to be on the windward side, or when lack of wind movement is compensated for by considerable temperature difference between the inside and outside.

C. When all doors to corridors and cloak-rooms are closed, since if they are not closed the cardinal features of window ventilation cease to exist.

D. When the teacher will watch the thermometers and adjust the windows every few minutes.

E. When no direct cold drafts strike the occupants except perhaps in their faces.

In explanation of the foregoing, please understand that we are discussing an ordinary class-room, having perhaps six windows and, say, forty occupants. It will be necessary, in order to approach the established standard of purity (6 parts CO_2 per 10,000), to introduce and remove around 1200 cu. ft. of air per minute. Presumably three windows can be considered as inlets and three windows as outlets, provided we have a corner room. To heat the 12000 cu. ft. per minute from, say, 30° F. to say, 65° F., will require under the inefficient contact conditions, at least 180 sq. ft. of

steam radiation in addition to that normally provided to offset losses and leakage. Not one window-ventilated class-room in a thousand has anything approaching such an excess amount of radiation. It is safe to say that the opening of windows in all such buildings is intermittent, governed by temperature and humidity conditions, and that practically under no conditions is the ventilation so obtained worthy of the name.

When indirect heating, operating without fans and without any direct radiators, is adopted, the air supply is warmed outside of the room to a temperature sufficient to prevent complaint from drafts, and high enough to furnish the heat lost through glass and wall exposures. Such systems are sure to furnish some sort of ventilation, as the heat cannot reach the room without air to carry it. This system of heating requires that a reasonable amount of skill be exerted in its design and operation, and is sensitive to variations in wind and outside temperature.

To alleviate these conditions the mechanical indirect system of heating and ventilating was developed, with power-driven fans forcing the air movement, and greatly improving the results.

OPERATING COMBINATION SYSTEMS.

A further combination is to add direct radiators in the rooms, and to reduce the temperature of the heated air, but this is a dangerous procedure, since with the radiators present the building may be heated and occupied, without operating the fans or obtain-

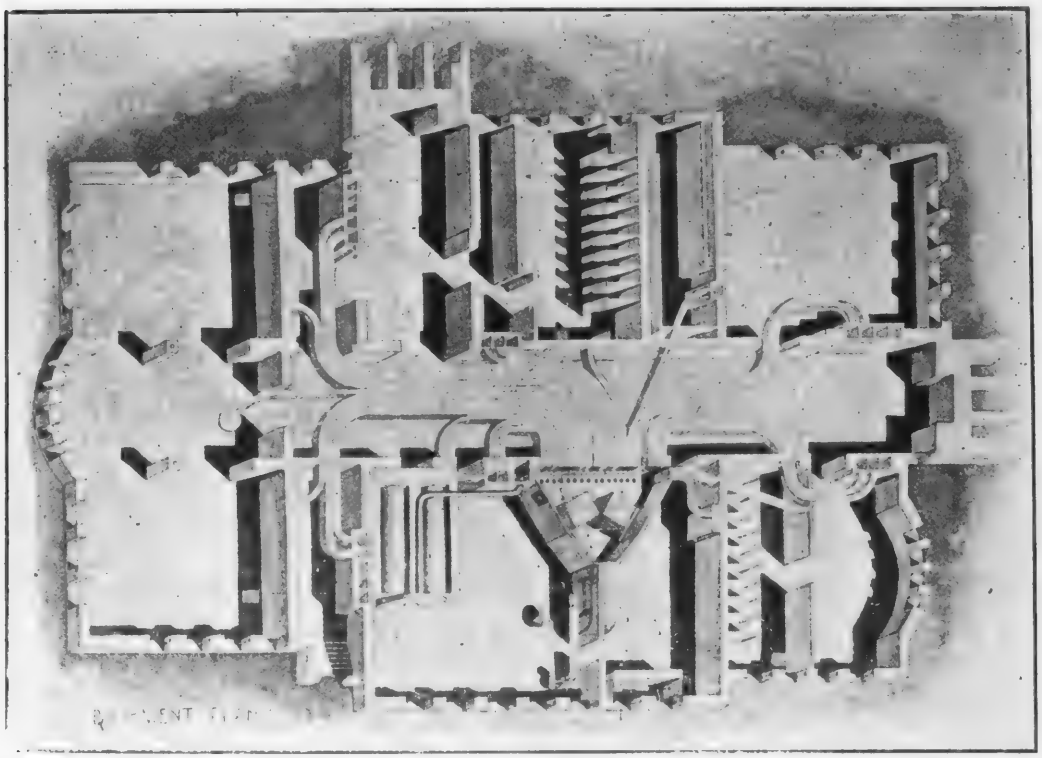


FIG. 3.

An all indirect, mechanical system of heating and ventilation, with a separate duct to each room from a central pressure chamber. At this chamber two temperatures of air are available, both under fan pressure, one for warming the rooms when they are too cool, the other warming only enough to prevent drafts, and for cooling the rooms after they become too warm. Air of constant volume, but varying temperature, may be delivered through any duct regardless of the temperature of the air delivered through any other duct, the temperature being varied by mixing dampers at the central chamber.

ing any ventilation. When separate ducts, each provided with a mixing damper, supply each room, as shown in Fig. 3, the temperature in the room can, of course, be maintained at any reasonable point. A popular measure, when auxiliary direct radiators are installed, is to provide a trunk line duct carrying air at one temperature to all of the rooms (Fig. 4). Consider then, a north room with large window area and few occupants, with a north wind outside; and a south room, sheltered, in the sunshine, and crowded with people. The air delivered must be cool enough not to overheat the south room, which would have all its radiators cold, yet warm enough not to chill the north room, which would have all its radiators hot. These considerations have proven that with a trunk line air supply and auxiliary direct radiators, we must provide for each room sufficient direct radiation to warm the room independent of any heat carried in by the air supply.

The combination of some local heat with the indirect system of ventilation gives the best results so far as practical operation is concerned, particularly in large buildings, though there is objection to the radiators, due to useful space occupied, local overheating, poor appearance, and improper air distribution.

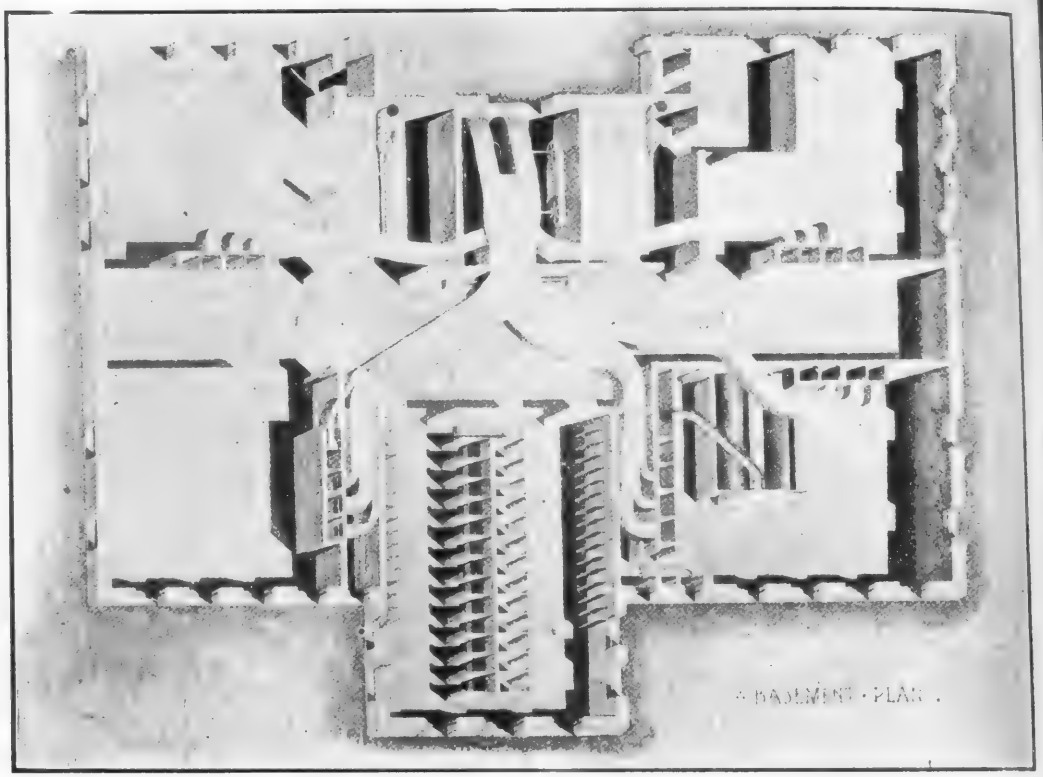


FIG. 4.

This illustrates the trunk line duct system, using direct radiators in each room for heating. Air at one temperature, about 70° F. is delivered for ventilation to all of the rooms. The room temperatures are controlled by admitting steam to or closing off the various radiators. Proper temperature regulation of buildings arranged in this way is rather difficult.

CONDITIONS TO BE MET IN VENTILATION.

The delivery of a given volume of air does not in itself constitute ventilation. The air must not only be in the proper volume, but it must be conditioned as to temperature, moisture, cleanlines, etc., and then must be delivered so that each occupant of each

room receives his share of it. Proper ventilation cannot be said to have been achieved even by the constant delivery of the proper amount of cleaned air to each occupant, at any given temperature and humidity, since very elaborate experiments as well as common sense indicate that our bodies and minds respond favorably to the stimulus of occasional sharp changes.

Some studies of this subject have seemed to indicate, for instance, that despite the serious objections to open-window ventilation, the average results as expressed in the effect on a large number of pupils, are superior to those obtained by the ordinary mechanical ventilating system, arranged with an unvarying temperature, a very low moisture content, constantly closed windows, and probably defective distribution of the fresh air.

So far, we have indicated that all the studies of ventilation that have been made are inconclusive, and we believe that no conclusive results can be obtained in the near future. The art is so young, the conditons affecting it are so obscure, and the response of the body is so involved with other factors, such as food, clothing, home conditions, predisposition to disease, etc., that we must move slowly and carefully and advance perhaps by a process of elimination.

We have, we believe, found that a school-room ventilating system will be favorable if the following conditions are fulfilled:

1. The room shall not be allowed to get warmer than 70° F. dry bulb, and 50° F. wet bulb.
2. The windows may be opened to the heart's content of the occupants.
3. No occupant shall be subjected unduly to direct radiant heat—that is, no one shall be compelled to sit closer to a radiator than, say, six feet.
4. No occupant shall be compelled to sit in an uncomfortable draft, caused by either air movement or great temperature difference.
5. The floor and the furniture shall have been warmed prior to occupancy to, say, within eight or ten degrees of the desired room temperature.
6. The entering fresh air shall be warmed by heaters or by dilution with the room air, or in some other way, to such an extent as to render its introduction a reasonably comfortable procedure, and this air shall be provided regardless of outside conditions, in proportion to the number of occupants of the room.
7. The air in its normal passage through the room shall sweep every portion of the same, and a lively air movement, say, thirty feet per minute, at and below the breathing zone, is desirable.

ARRANGEMENT OF SCHOOLHOUSE HEATING AND VENTILATING PLANT.

The following are some observations concerning the schoolhouse heating and ventilating plant as applied to the whole building rather than to class-rooms in particular:

A. The toilet rooms should have separate exhaust ventilation, so that a lower pressure is always maintained in these rooms, causing a constant air movement into the toilet rooms from the building, and never out of them into the building. The ventilation of the toilet rooms should be independent of the heating system, or of the outside temperature.

B. Chemical laboratories and other similar sources of contamination should have independent exhaust arrangements, and since the chemical exhausters are often required to handle products heavier than air, they should

be localized for laboratory ventilation only and never combined with other functions.

C. The plan of the building should be such that there is no possibility of the air supply to the room entering the same after passing over the contents of the cloak-rooms or wardrobes, not because it has been proven that any particular contamination results therefrom, but because well-defined odors do originate there, which it is more pleasant, at least, to avoid.

D. With all deference to and appreciation of the observations which have been made of results on the physical and mental condition of the occupants of rooms having skillfully manipulated windows, without any other ventilating apparatus, we believe in the necessity of some scheme of air renewal and movement which shall be reasonably independent of the human element and of outside conditions. With full appreciation of the desirability of change and cold shock for hardening and toning up the body, we are fully convinced that the ordinary school faculty is unable judiciously and consistently to provide such conditions. Furthermore, with mild weather, no wind or heavy precipitation in effect outside, even the most skillful arranging of windows will fail to create adequate air movement. Any person who has experienced the well-known musty and stale odor which persists in school buildings having only window ventilation, will, we believe, subscribe to the necessity for a better condition. Therefore, mechanical ventilation, with full license as to window opening, is at present our best recourse.

E. With mechanical ventilation the source of power should be very reliable and as low in cost as practicable. Electric current from public utility plants is a convenient power, though subject to interruption from sleet storms, and usually costing several dollars per day for even medium-sized installations. Because steam usually is used for heating, steam power is nearly always the cheapest and most reliable for running fans. With steam as the heating medium, it is simple and economical to provide for air moistening, for hot water heating for showers, pools, etc., and to get very rapid results by using a vacuum system of steam circulation. With steam, the most distant and exposed rooms may be heated as thoroughly and quickly as the nearest rooms, and the toilets and offices may be kept warm at low cost without heating the class-rooms. A comparatively low steam pressure can be maintained; there is no danger from the boilers; and while a licensed engineer is highly desirable, his services will cost no more than those of any other equally competent custodian. With a medium pressure boiler plant, the cheapest coal can be burned without objectionable smoke. While it may be inconvenient it is entirely practicable to operate the fan for ventilation without heating the air at all. Experience, however, indicates that when no heat is necessary, the better ventilation usually may be obtained by opening wide all the windows.

F. It is probable that in a state of nature we would be compelled to live in a tropical or nearly tropical climate. We have, by the aid of artificial heating, learned how to live in temperate and even in arctic conditions. Our heating arrangements must be capable of keeping us reasonably comfortable in the very coldest weather. While there are physical sacrifices we must make for the sake of having these artificial heating plants and the housing that must accompany them, these sacrifices are as nothing compared wih the suffering, illness and mortality we should encounter if we were deprived of artificial heat altogether. Our heating apparatus is pow-

erful enough for the coldest weather, although we have coldest weather only a few days and have great variation in outside temperature nearly every day. Therefore, most of the time the heating apparatus, unless consistently checked, will cause overheating, and a little overheating is far more harmful to us than a little underheating.

Teachers are valuable first, we believe, for their concentration to the work in hand, of observing, guiding and correcting the mental processes of the pupils. Teachers are notoriously incompetent when it comes to preventing overheating or under-heating or to manipulating ventilation. While they remain in the rooms, their normal senses cannot possibly react quickly to conditions there. Very material losses in fuel are occasioned by overheating, as well as losses in efficiency and losses in resistance to disease by the pupils.

Because of these losses and the failure of any other means of preventing them, there has been developed a very efficient system of automatic prevention of overheating, which is called automatic temperature regulation. It cannot cause a deficient or arbitrarily-controlled heating plant to furnish more heat, but it does draw the line at any reasonably set maximum temperature.

In connection with the temperature regulation, we have also a device which automatically will turn off or on the means of air moistening as the relative humidity encroaches upon certain limits either way.

Also, we can use the compressed air which is the motive power of the temperature controlling plant as a very efficient and satisfactory medium for remote damper and valve control. Such remote control is highly desirable, as for closing off ventilation when the building is unoccupied; for shutting-off certain departments as for night school; for stopping ventilation of an assembly hall when the room is not needed, etc.

(In next month's issue Mr. Lewis will illustrate and describe a typical school-house heating and ventilating system in which are embodied many of the suggestions contained in the foregoing discussion.)

Sizing Ducts and Flues by Method No. 6.

In connection with Standard Data Sheet No. 10-T, published in this issue, and describing the sizing method for ducts and flues used by the Buffalo Forge Company (Method No. 6), the Buffalo Forge Company states:

"This method, which is explained quite elaborately, may seem clumsy, but if so it is only because we go into so much detail in explaining it, for in actual operation it is very simple and insures excellent results.

"We might add that in most installations we reduce friction by enlarging the area of the ducts so as to decrease the velocity gradually from the fan outlet to the end of the main duct, and this diverging nozzle effect gives a regain due to the transformation from velocity head into static pressure. This regain adds to the effective head, and thereby makes it possible to reduce the speed and horsepower of the fan as compared with what would otherwise be necessary. We have found by experiments that the amount thus added to the effective head corresponds to two-thirds of the difference between the velocity head at the fan outlet and the velocity head at the 5-in. straight section of main duct. For example: Suppose that we have a velocity of 2533 ft. at the fan outlet corresponding to 0.4 in. water gauge, and that this velocity is reduced at the end of the straight run of ducts to 1800 ft. per minute corresponding to approximately 0.2 in. water gauge, there will be a regain of two-thirds of this difference or about 0.13 in. This is sometimes an important item and while not properly a part of the method of designing ducts, it should be taken into consideration in arriving at the total frictional resistance of the system.

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WHATEVER effect the war may have on other industries, it is evident that the Government's programme for the inspection and possible rehabilitation of heating and power plants will create a market that will tax the resources of the manufacturers in this field to the utmost. Many of the supplies needed will come within the preferential Government list, so that the trade, as a whole, will have nothing to fear in the way of embargoes.

The principal cause of this remarkable state of affairs lies in the drastic action taken by the United States Fuel Administration regarding the supply of coal to power plants throughout the country. As has been announced in these columns, the supply will be limited and plants shown to be wasteful due to inefficient equipment or improper operation will be driven to more economical measures or have their fuel supply cut off altogether. The personal inspection, which is being conducted under Government auspices, specifically includes plants in office buildings, hotels, and apartment houses, so that the campaign is far from being limited strictly to power plants. By the time the inspection of each plant is completed, if not before, the need of at least some new equipment will no doubt be demonstrated. In fact, the Fuel Administration is figuring on a movement to improve the plants, if necessary, so that they may be rated in a high class by the time the inspector calls.

DURING recent years we have heard on all sides the slogan of "Fuel Conservation." The gospel of smokeless combustion has been preached far and wide, and burners of coal, from the power plant operator to the householder, have been deluged with rules and suggestions for getting the last heat unit out of his fuel. It is true that the power plants, in no small measure, have heeded the call, but as much cannot be said of the average householder.

But now, how different the situation! According to announcements of the Fuel Administration we are about to be told how much coal we may burn during the heating season and we may rest assured that it will be the minimum of our requirements.

Every user of coal, therefore, in the country is interested in ways and means of reducing his coal consumption and, consequently, in improved apparatus and appliances that will accomplish that end. It has been the custom of THE HEATING AND VENTILATING MAGAZINE for several years to make the October issue a "Smokeless Boiler Number." In view of the new situation this year's number will be known as a "Fuel Economy Number" and will appear in September in time to be of service before the opening of the heating season.

Mechanical Engineers' Symposium on Fuel Conservation

Although the fuel session, at the recent Worcester meeting of The American Society of Mechanical Engineers, was all too short for the discussion of the various topics listed, the full discussions, both verbal and written, have since been published in the society's *Journal*, forming Part 2 of the July issue. The discussion started with a presentation of the government's plan for fuel conservation, by David Moffat Myers, advisory engineer of the United States Fuel Administration. At present, he said, the Fuel Engineering Division is devoting itself exclusively to the work of conservation of fuel in stationary power plants, and in the efficient use of steam after its generation. The railway department is already working under a plan of organization devised by Major C. Schmidt, U. S. R., which Mr. Myers characterized as the work of a master mind.

The organization covering the stationary power plants comprises the central office at Washington, with an administrative engineer appointed in each coal-using State, attached to the Federal Fuel Administration of that State. The Administrative engineer has a consulting board of competent engineers and a staff of technical and clerical assistants and inspectors.

The plan of organization involves centralization on essential fundamentals only. These are uniform for all States. All other features are localized and extremely elastic in their numerous ramifications. This adopted principle renders the plan workable and effective under widely varying local conditions and circumstances.

The fundamentals of the national program are as follows:

Personal inspection of every power plant.

Rating and classification of every power plant in the country, in five classes, depending upon the thoroughness with which the owner conforms to the recommendations of the U. S. Fuel Administration.

At the discretion of the Federal Fuel Administration, the supply of coal to any needlessly wasteful plant may be curtailed or stopped.

The plan is now in operation in Pennsylvania, the largest coal-consuming state, and also in Connecticut. Other States which have come in but in which the administrative engineer is not yet appointed, are Massachusetts, New York, New Jersey, Illinois, Michigan, Wisconsin, Indiana and Missouri.

STANDARD RECOMMENDATIONS OF FUEL ADMINISTRATION.

The standard recommendations of the United States Fuel Administration are substantially as follows:

Fuel. That means be provided for measuring and recording fuel used each shift or day.

Water. That boiler feedwater be heated ing surfaces be kept clean inside and out. by exhaust steam or waste heat, and measured.

Air Supply. That a correct amount of air be supplied to the fuel, and that proper means be provided for measuring and regulating the draft.

Clean Heating Surfaces. That boiler heating surfaces be kept clean inside and out.

Boiler and Furnace Settings. That the furnace and setting be kept in good repair, and free from air leakage.

Insulation. That exposed steam surfaces wasting heat by radiation be covered with suitable insulating material.

Engine-Room and Heating System. That wherever possible, exhaust steam be utilized to the exclusion of direct steam from the boilers. (The plant should be designed and operated to produce no more exhaust than can be efficiently utilized in heating and process work.)

Supervision. (1) That a competent employee or committee be detailed to supervise the work of fuel conservation in the boiler and engine plants; and (2) that a competent committee be appointed in charge of the work of fuel conservation in the buildings and shops outside of the power plants.

To assist in this work, the United States Fuel Administration has prepared a fifty-minute film of moving pictures, showing good and bad operation in the steam-boiler plant, methods of testing boilers, fuels, etc. These pictures will be available to each State, in connection with their publicity and educational propaganda.

The fuel administration is also preparing a series of official bulletins on engineering phases of steam and fuel economics. Some of these are now in press. They will include: Boiler and Furnace Testing; Flue-Gas Analysis; Saving Steam in Heating Systems; Boiler-Room Accounting Systems; Saving Steam and Fuel in Industrial Plants; Burning Fine Sizes of Anthracite; Boiler-Water

Treatment; Oil Burning; and Stoker Operation.

In addition to this service, a list of competent engineers has been prepared in Washington for each State, and is available for use of the local administration. As the work develops, still further constructive assistance is contemplated for helping owners to bring their plants up to a high plane of economy.

LIMITING COAL IMPURITIES IN PENNSYLVANIA.

On this subject a striking address was delivered by E. L. Cole, secretary of the Conservation Division of the Federal Fuel Administration of Pennsylvania, in which he told how the amount of impurities in anthracite and bituminous coal increased during the winter months of 1917, in spite of friendly suggestions made to operators. The fuel administration then formulated rulings limiting the percentage of slate, bone and under sizes that would be permitted by the Government in all sizes of anthracite. Inspectors were appointed to condemn all coal in a given section found below standard. Mr. Cole said a vast improvement has resulted, the May returns showing that less than one-half of 1% of the daily anthracite production of more than 250,000 tons was condemned by the Federal inspectors. This coal was condemned at the mines and reprepared for delivery.

It is the observation of the Fuel Administration, he said, that steam sizes of anthracite containing 40% of impurities are so inefficient in generating steam that the cost of such fuel is commercially prohibitory.

FUEL-OIL SITUATION

The fuel-oil situation was presented by President Alfred C. Bedford of the Standard Oil Company of New Jersey who said that he wished to plead for special economy in the use of fuel-oil and for its use only where, from the nature of the work, coal cannot properly be used. He said he did not care to be thought an alarmist, but when the needs of the navy are considered, together with those oil-burning cargo ships, it was easy to see that our consumption will be, as it was in 1917, in excess of our production. He said factories in the East must be asked to burn less fuel oil on account of the difficulty of transporting it from the Mexican oil fields. Particularly, fuel oil, he said, should not be used under steam boilers, either stationary or locomotive.

The symposium itself took up, among other things, "What is essential to the economical operation of hand-fired boiler furnaces when using soft coal?" "What experience have you had in the use of wood as fuel? To what extent is wood available as a fuel?" "What coal economies can be effected in residence heating?" and "What coal economies can be effected in small steam plants?" and, under miscellaneous, "School Heating, Insulation and Smoke Prevention."

COAL ECONOMIES IN RESIDENCE HEATING

Frank T. Chapman, who spoke on this topic, said: According to good authority approximately 120,000,000 tons (2000 lbs.) of coal is the present rate of use per year for domestic purposes in the United States. No accurate record exists to indicate what proportion of this coal is used for residence-heating purposes, but probably at least two-thirds, or 80,000,000 tons, of this amount is used for what might be broadly stated as residence heating.

The possible saving in coal used for residence heating may be divided into five principal items as follows:

1 Elimination of Heating for Unnecessary Rooms and Buildings:
   a Shutting heat off from rooms not actually needed.
   b Closing of large residences where heating requirement is unreasonable for number of occupants or the re-arrangement of heating equipment in order to heat only the portion of house actually needed for occupancy. (This item should represent a saving of at least 10%.)
2 Lower Temperature Maintained in Homes:
   a A 5° lower average than past practice would save about 10% of the fuel requirement.
3 Observance of Practical Methods of Reducing Preventable Heat Losses:
   a Insulation of cellar piping, heater or other sources of heat loss.
   b Prevention of undue leakage at windows and doors.
4 Economical Operation of Heating Apparatus:
   a The keeping of gas passages of heaters clean. (By far the most vital factor and the most important to emphasize.)
   b Proper draft regulation.
   c Sifting ashes where they contain fuel value.
   d The study and application of available war coal-saving rules. (This item No. 4 should represent a possible saving of 20%.)
5 The Use Where Available of Substitutes for Coal as Fuel, such as natural gas, kerosene oil, fuel oil, wood, peat.

A summary of these possible savings totals a proportion of about 50% of the coal now used for residence heating. For practical calculation let us assume that one-half this proportion, or 25% of the saving, can actually

be effected, provided proper means are used to inspire, educate and require the public to take a more personal interest in conserving coal. Based upon 80,000,000 tons, 25% would mean a saving of 20,000,000 tons in residence-heating work, to which could undoubtedly be added a goodly percentage of coal now used for domestic cooking and hot-water service, by increased economy in its use and by a more extensive substitution of other fuels for cooking.

The practical possible saving on all domestic uses of coal would, therefore, appear to lie somewhere between 20,000,000 and 30,000,000 tons. It is important to note that in this 25% saving, only 10% is figured as secured from "economy of operation," the remainder being mainly by elimination and lower maintained temperatures.

Having visualized the first two phases of the subject question, we come to the third phase, viz., the method of procedure that will bring about the greatest conservation. This phase is only indirectly covered by the original subject, but is the vital factor which governs the proportion of the possible economies that can be effected.

An active educational program with punch and compulsion in it, as well as an appeal to patriotism, is required, and such a program must necessarily be based upon a plan of regulation and limitation of coal supply calculated upon quantities requiring economy. Only by such means can the average householder be aroused and impressed with the fact that if he does not study and apply the conservation rules, his negligence will react upon the comfort of his own family. He will run short of coal, while his neighbor who has observed the rules will have sufficient for his needs.

Information accumulated leads to the statement that a sufficiently consistent plan of apportioning coal for residence heating, cooking and hot-water service by regulation and limitation, can be secured in making the enforcement practical.

COST OF SCHOOL HEATING.

J. H. Brady, chief engineer and superintendent of buildings for the School District of Kansas City contributed a report made by him to the Board of Directors of the School District of Kansas City, Mo. This report is given in great detail and is extremely valuable. It contains a tabulated statement for 1916-17, showing the cost per cubic foot for heating the buildings of the school district.

There are 88 public buildings having a total cubic contents of 32,300,000 cu. ft. and an average per building of 367,000 cu. ft. More than half the buildings contain over 250,000 cu. ft. of space and several are much larger. The cost of fuel for all the buildings averaged 3.1 mills per cubic foot. The figures given in the report include the fuel furnished the custodians of the buildings for their residences, except in the case of seven buildings. In what follows is a brief summary of the conclusions:

Grouping the buildings accordings to the type of heating plant used gives the following results:

Group No. 1, steam hot blast, using fuel oil, average cost 3.5 mills per cubic foot.

Group No. 2, direct radiation, using fuel oil, average cost 3.6 mills per cubic foot.

Group No. 3, steam hot blast, using coal for fuel, average cost 2.8 mills per cubic foot.

Group No. 4, direct radiation, using coal, average cost 2.9 mills per cubic foot.

Group No. 5, frame and brick buildings heated by stoves, average cost 4.1 mills per cubic foot.

Group No. 6, schools heated by hot-air furnaces, using coal, average cost 3.6 mills per cubic foot.

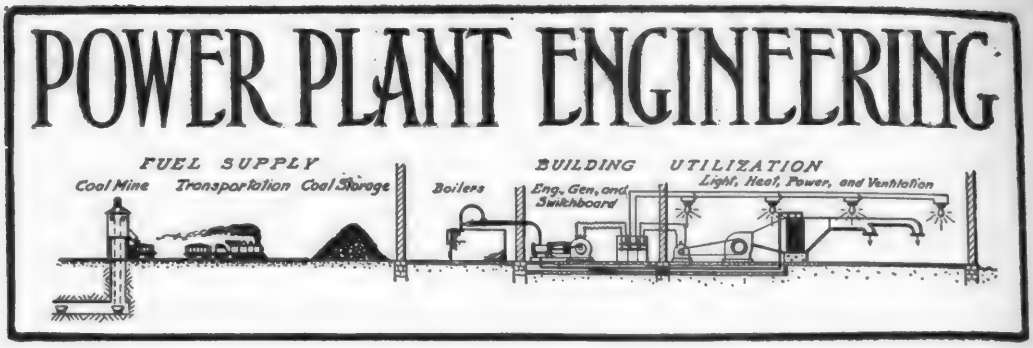
Contrasting two of the buildings, the writer states:

"Central High School shows a cost of 2.7 mills per cubic foot while Northeast shows a cost of 2.5 mills per cubic foot. The cubic contents of Northeast High is greater than Central High, and the difference in the cost per cubic feet for heating the two buildings is, in my opinion, due to the fact that Central High has metal frames and sash while Northeast has wooden frames and sash, and the leakage of air or wind around metal sash is greater than with wooden sash. Both these buildings use coal for fuel. As a rule the high cost of heating certain buildings is caused by metal frames and sash, while in other buildings it is due to poor construction, taking into account their age, etc."

Another point is the fact that where mechanical ventilation, or what is known as hot blast fan system, using coal for fuel, is installed, the cost for heating per cubic foot, is less on an average than the others, being 2.8 mills.

The fact that the figures for schools equipped with mechanical ventilation run less than for those not so equipped may be attributed to automatic temperature control. The highest cost per cu. ft. is shown where stoves are used for heating, being 4.1 mills.

POWER PLANT ENGINEERING



Steam Turbines for Building Power Plants

It is remarkable that, with its inherent advantages, its simplicity, and its clean exhaust steam, the steam turbine has not been more largely used in the building power plant. Probably the chief causes is the comparative newness of the development of small-size turbines, the fact that the manufacturers of such machines are still limited in number and that it is easier to secure operating engineers for simple and even Corliss engines than it is to secure one for steam turbines. To the operating man the turbine seems to have given a general impression of mystery from which he assumes its operation to be complicated, its parts incomprehensible and he, therefore, feels more helpless and has much less self-confidence when asked to run a turbine than when a plain engine proposition is placed before him.

Now what are the facts of the case? Is the turbine more complicated and is it more difficult to operate than an engine? Is it harder to repair and are its repairs and adjustments required more frequently than the simpler types of engines or are they not?

Of course, the reader is familiar with the principle of turbine operation, viz., the shooting of jets of steam against the recesses on the side or circumference of the rotor which is thus "blown" around, as one might say, by the force of the steam impinging on these recesses. The old mill wheel with its paddles set in a swiftly-running stream is an example of this; the side wheel and stern wheel steamboats are another,—but with the action reversed—(in this case the wheel moves the water by the power supplied from the engine instead of the water moving the wheel and furnishing power *to* the engine).

The actual wheel as employed in the Terry steam turbine is shown in Fig. 1 and the action of the steam on the wheel is illustrated in Fig. 2. Therefore, the apparatus consists simply of such a wheel—or several wheels—mounted on a shaft and against which the steam jets are directed from one or more nozzles. The turning of the wheel or wheels which are keyed onto the shaft of course turns the shaft which is connected to a generator, alternator, pump or other apparatus to be operated.

EARLY FAULTS OF CONSTRUCTION REMEDIED.

Formerly, these wheels were a weak feature of turbine construction, being arranged so that the clearance between the wheel and the casing was very small. An interference or *rubbing* between the wheel and the casing with this resulted from the slightest distortion of the shaft or temperature move-

FIG. 1.—WHEEL OF TERRY STEAM TURBINE

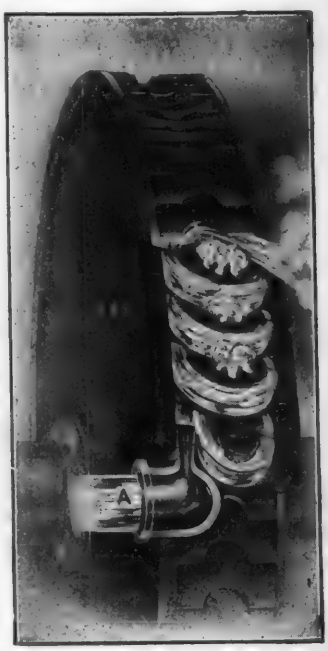


FIG. 2.—ACTION OF STEAM ON WHEEL.

ment of the casing. The buckets were also arranged so that any such interference would be almost sure to injure them beyond repair, making a replacement necessary. With the present turbine models this danger is eliminated, first, by using larger clearances—sometimes 1½ in. or so—and, second, by building the wheel so that rubbing on the sides or circumference comes on a projecting ring, thus protecting the buckets which are set slightly inside the protecting ring. Having eliminated all danger of smashed or damaged buckets no further worry need be felt on this score but how about the adjustment?

If the expansion and contraction of the casing due to heating and cooling by the steam, or by the twisting of the supply and exhaust pipes connected thereto takes place to any reasonably slight degree there is more than enough clearness to prevent any serious interference from this cause; so this objection is also eliminated. With these two features properly taken care of in the design there is nothing else to cause trouble as this casing and wheel described *constitute* the turbine as is indicated in the interior view of a Terry steam turbine of which a cross section is shown in Fig. 3.

CLEAN EXHAUST STEAM SECURED WITH TURBINES

If it is assumed—as may safely be done—that the steam turbine as a mechanical machine is beyond reasonable criticism, what other merits has it to recommend it for small building power plants? Probably the most unusual feature is the clean exhaust received from such machines. Referring to Fig. 3, it will be noted that there is no need, or even opportunity, to apply oil to the interior, the only oiled surfaces being the two main bearings outside the casing. This not only results in clean exhaust without oil but at the same time eliminates the use of oil separators, grease traps and greasy drips. A further gain is made in the quantity of oil used.

SMALL SPACE REQUIRED

A second great advantage is *space*. A steam turbine can be set up in a fraction of the space required for an engine of equal capacity. To realize the tremendous difference it is only necessary to refer to Fig. 4 where the comparative plans and elevation of a 100-H.P. engine and a 100-H. P. turbine are shown, both drawn to the same scale. More than that, the space for drawing pistons is not needed in a turbine, in fact, besides the necessary access aisle around the machine no other space is necessary for dismantling. The smallness and compactness of such an outfit is further illustrated by Fig. 5 which is a Sturtevant turbine direct-connected to a D. C. generator.

DEPENDABLE SERVICE FOR LONG PERIODS

After setting up and starting a turbine no further attention except oiling is required until the bearings wear out and need to be re-lined. There is no matter of adjustment to be constantly kept in condition and no

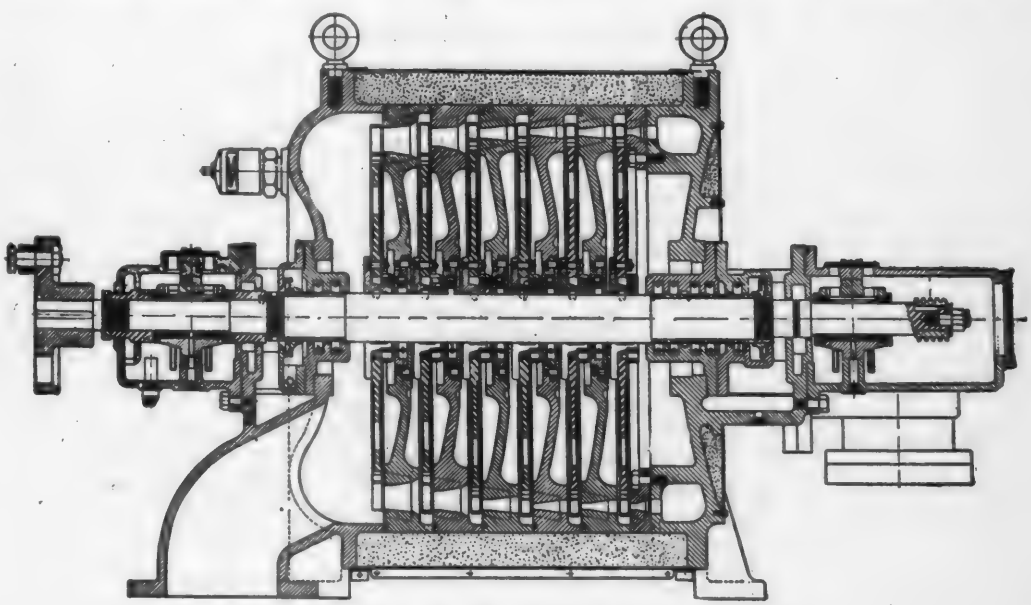


FIG. 3.—CROSS SECTION OF TERRY STEAM TURBINE.

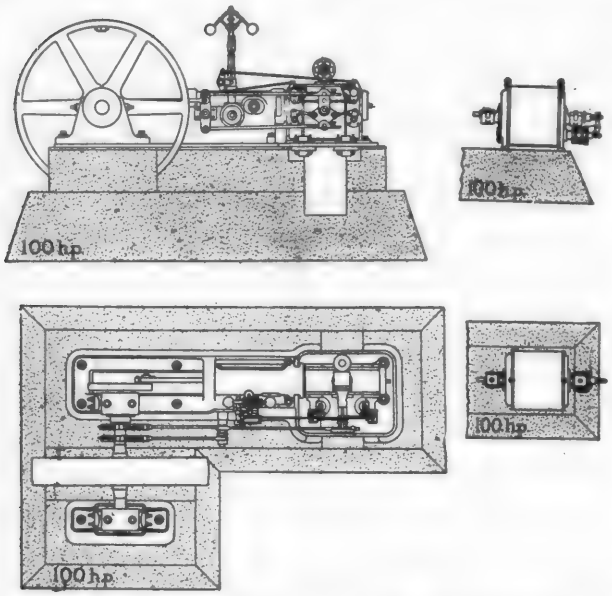


FIG. 4.—COMPARATIVE PLAN AND ELEVATION OF A 100-H.P. ENGINE AND A 100-H. P. TURBINE.

loss of efficiency is possible through an incorrect setting of valves or cut-off. Turbines tested after years of hard service have shown practically the same steam consumption and the same economies as when installed.

The long periods during which these machines will give constant and dependable service renders them particularly suitable for building power-plant service. The writer was recently in a small plant supplying light and power to four or five little isolated buildings where a small turbine had been started six months previously and had been running night and day every minute since. According to all indications it might easily be many more periods of six months before anything would require its stoppage.

Now as to regulation—are these machines capable to close speed regulation such as is necessary for generators and alternators supplying current for lighting to avoid flickering of the lamps? In regard to this it might be said that the turbine is capable of just as close regulation as an engine, the speed variation under practical test on a 125 Kw. machine being 1.17% from no load to full load, and it may always be kept within 3% of normal from no load to full load on small machines and within 2% on larger units. Closer regulation may be obtained if desired.

It must not be assumed that the small turbine has not already been used in building power-plants for many buildings although, of course, they by no means are as numerous nor in as common use as the well-known steam engine of various types.

Fig. 7 shows a view of two Terry turbines of 50, and 125-Kw. capacity, respectively, and one General Electric Co. 75-Kw. turbine installed in a Hartford, Conn., department store.

OPERATION UNDER PARTIAL LOADS

Still another advantage which can be obtained with steam turbines of some types where nozzles are used in higher efficiencies under partial loads. For instance with a four-nozzle machine, with 20% of the full load, only one nozzle is used; with 40% or 50%, two nozzles, etc. A curve plotted to show the economy so obtained is shown in Fig. 6. Here the consumption at full load is shown starting off and increasing as indicated by the dotted line. But the gradual closing of the five out of six nozzles as the load falls off keeps the steam consumption down to the levels indicated by the heavy lines.

FOUNDATIONS LIGHTER THAN FOR RECIPROCATING ENGINES

In spite of the very high speeds obtained in steam turbines (running from 3600 R. P. M. downward) the foundations required are much lighter than for reciprocating engines of similar capacity. This is because in the turning of the rotor it finds its own center and maintains its own stability, not being subject to shocks caused by the sudden change in the movement of large masses of

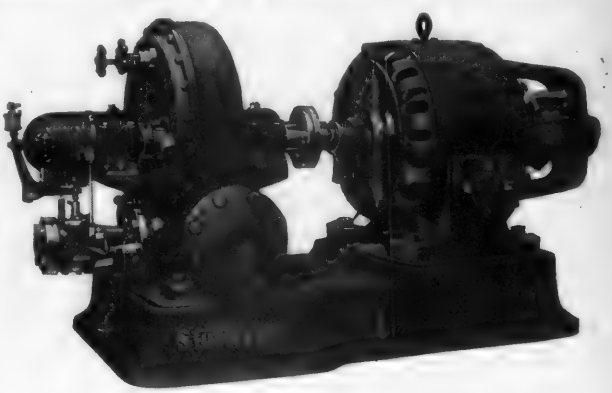


FIG. 5.—STURTEVANT TURBINE DIRECT-CONNECTED TO A D. C. GENERATOR

metal as is the case with an engine. Under these higher speeds a smaller and, therefore, a less expensive electric machine can be used as it is well known that a generator will produce more power at a higher speed.

One of the chief items of expense in a

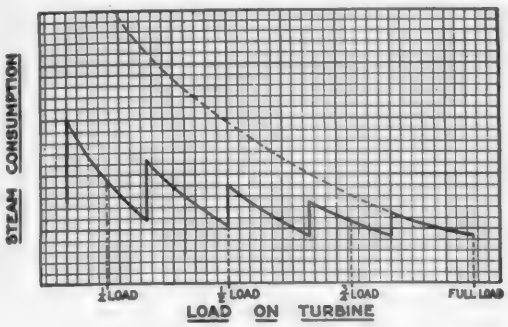


FIG. 6.—ECONOMY CURVE

small power-plant are the large slow-speed generators it is necessary to use for direct engine connection whereas with turbines the electric manufacturers have been hard pressed in some cases to produce an electric machine that will stand up under the direct drive of higher speed turbines.

There are other items in the power plant besides the main units, however, which can profitably utilize turbine drives in preference to electric motors. Turbine-driven forced-draft fans, turbine-driven boiler-feed pumps, and turbine-driven circulating pumps are becoming more and more common and, compared to the electric motor, their efficiency is much higher as their exhaust can be turned directly into the feed-water heater or steam heating system.

An Hour's Study per Day Proposed for Technical Men.

The question is raised by a writer in the American Association of Engineers' Journal whether it is not advisable for every employer or manager of technical men to require them to read and study, say, an average of six solid hours weekly and the opinion is expressed that such a procedure would repay the employer richly, even if the entire six hours of study were at the employer's expense.

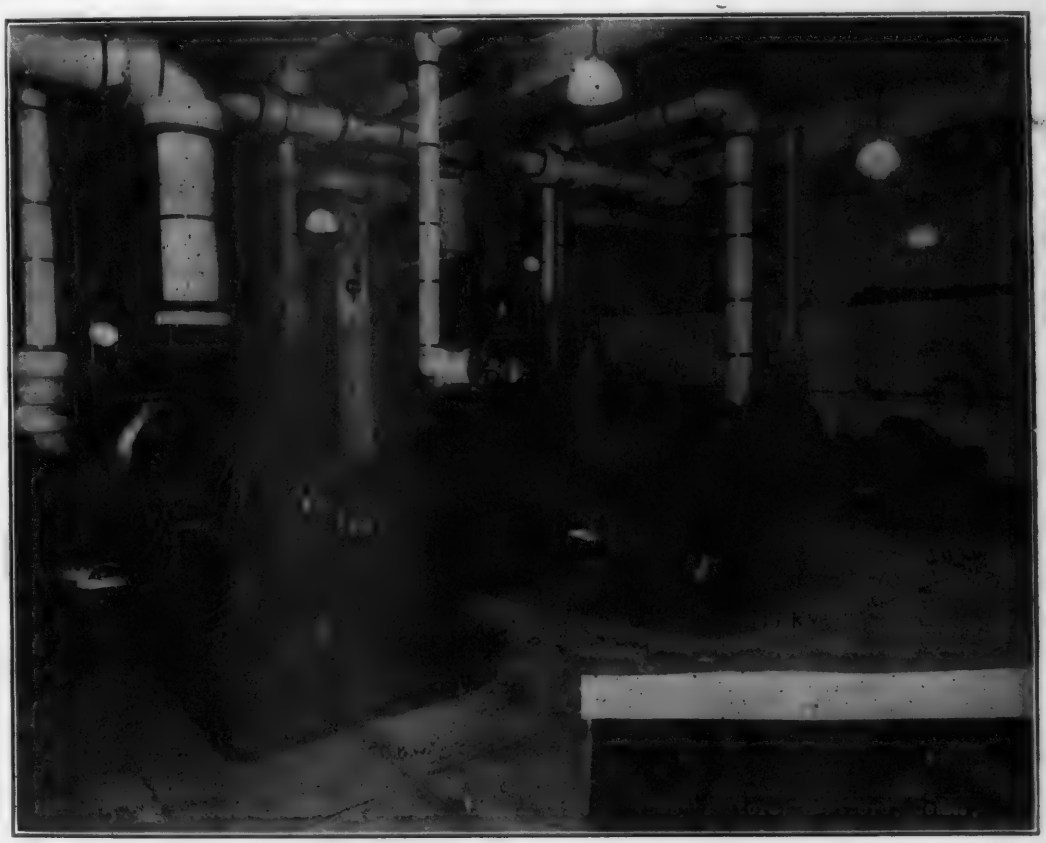


FIG. 7.—STEAM TURBINE INSTALLATION IN HARTFORD (CONN.) DEPARTMENT STORE.

Modern Practice In Vapor Heating

EDITOR'S NOTE—*For the purpose of this series of articles, a vapor, vacuum, vapor-vacuum, vacuum-vapor, atmospheric, modulated or themograde system of heating will be considered as any system in which the steam pressure ordinarily carried is practically at atmosphere or slightly below or in which the returns are open to the atmosphere and where no pump or other positive mechanical device is employed to pull back the returns.*

II.—THE HUTCHISON SYSTEM.

The next patented system to be considered on this series is that of the Hutchison system of vapor heating, manufactured by the Hutchison Vapor Heating Corporation, Washington, D. C. which possesses some features in common with the Adsco system described in a previous issue. This resemblance extends to a modulating valve on the supply end of each radiator and a union elbow on the return connection which, in turn, involves the use of an excess of radiation to avoid vapor getting into the return lines. The chief points of difference lie in the "trap receiver" and "damper regulator" employed.

The chief requirements consist of such items as

A graduating valve on the supply end of each radiator and a union elbow on the return end.

A special trap receiver on the return, a special regulator to control the drafts, a special safety valve and an air vent to relieve the air.

Additional radiation of 20% on each radiator in order to be sure of condensing all vapor in the radiator.

The piping required for this system is illustrated in Fig. 1 the steam (or vapor) being generated in the boiler and flowing out through the supply mains and risers to the graduating valves on the radiators.

In piping the steam main the riser from the boiler should be run up full size of tapping and should be reduced at the first elbow or tee to the proper size. The main may be run by the circuit method, starting high at the boiler and, running around the building, pitch constantly down until the main has returned to the boiler location at which point it is dripped by a bleeder connected into the boiler return below the water line. On larger systems the split main is used as illustrated.

If for any reason it is desirable to jump the main at any point all that is necessary is to carry the main pitching down to the point where the jump is to be made, take a bleeder off at this point (connected back to boiler under the water line) and raise the main as much as desired. This is illustrated in Fig. 2.

The grade of the mains should be made not less than 1 in. in 20 ft. where the steam and condensation flow in the same direction and 3 in. in 20 ft. where the condensation and steam flow in opposite directions.

The size of the steam mains is based on the length of run, square feet of radiation, and number of elbows in the line. Table I shows the proper sizes for various conditions, allowing 2 oz. loss in pressure from the boiler to the last radiator and in measuring up the length of run 10 ft. is added for each 90° elbow.

TABLE I

Nominal Size of Pipe In. Diam.	Length of Run of Main in Lineal Ft. 100 ft. or less	100-150 ft.	150-200 ft.	200-300 ft.
	Radiation in Square Feet.			
1¼	160	145	122	100
1½	265	210	190	150
2	520	450	380	310
2½	860	700	600	490
3	1500	1250	1070	900
3½	2200	1800	1550	1250
4	3300	2600	2200	1800
4½	4500	3700	3200	2600
5	6200	5000	4400	3600
6	....	8400	7200	5800

Where bleeders are installed the sizes should be as given in Table II.

TABLE II

Size of Main In. Diam.	Run of 0-150 Ft., In Diam.	Run of 150-300 Ft., In Diam.
1¼ and 1½	1	1
2 to 3	1	1¼
3½ to 6	1¼	1½

Where the risers are higher or have numerous connections they should be sized on the same basis of the steam main using the distance from the top of the riser back to the boiler as the length of run and adding 10 ft. for each 90° elbow.

The graduating valve is of the packless type and opens and closes a port by the movement of a tapering slot attached to the valve spindle across the port opening as illustrated in the sectional cut, Fig. 3.

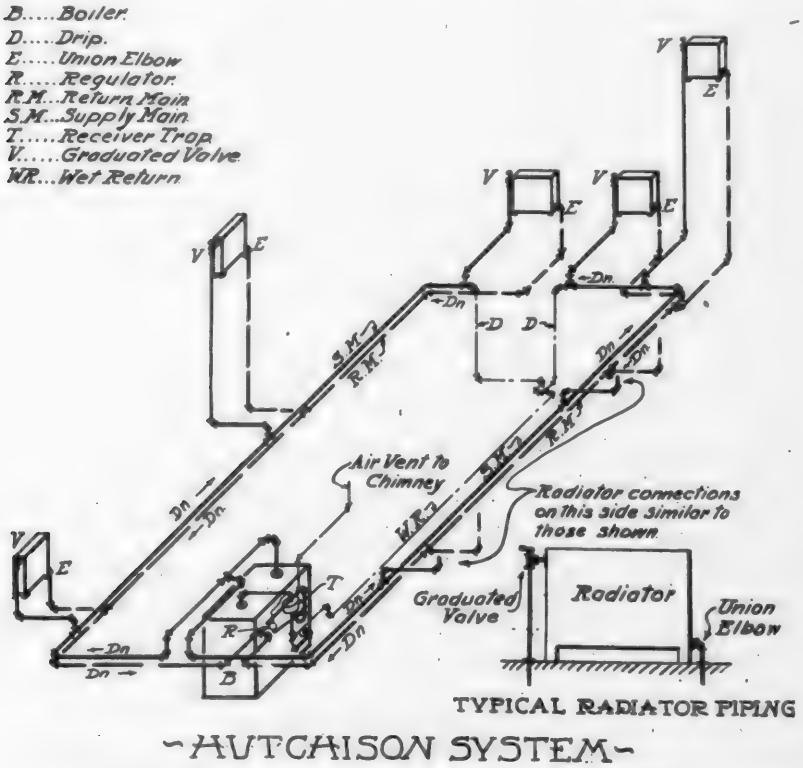


FIG. 1.—TYPICAL LAYOUT OF HUTCHISON SYSTEM.

with a maximum length of 1 in. bleeder pipe limited to 55 ft.

Where risers go to only one radiator on the second story the riser may be made the same size as the radiator branch, but when two or more radiators are supplied the size of the riser depends on its distance from the boiler as shown in Table III.

TABLE III

Nom. Size of Pipe In. Diam.	Distance from Boiler in Feet 100	150	200	300
	Square feet of radiation supplied.			
1	80	66	56	46
1¼	160	145	122	100
1½	265	210	190	150
2	520	450	380	310

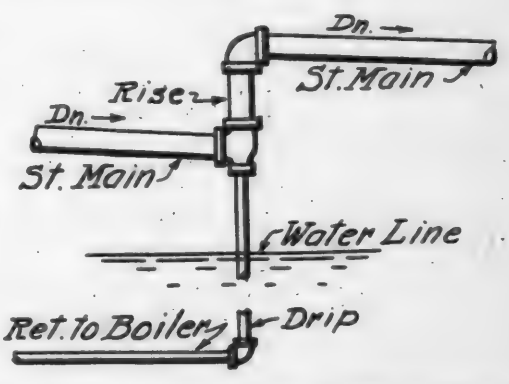


FIG. 2.—ARRANGEMENT FOR "JUMPING" THE MAIN.

The dimensions of this valve as indicated on the diagram, Fig. 4 are as follows:

Size of Valve Inches.	a Inches.	b Inches.
½	1¼	3
¾	1⅜	3
1	1⅞	3¼

The graduating supply valves are calibrated so that ½-in. valves are suitable to use on radiators of 30 sq. ft. or less; ¾-in. valves on 31 to 90 sq. ft. and 1-in. valves on radiators of 91 to 180 sq. ft.

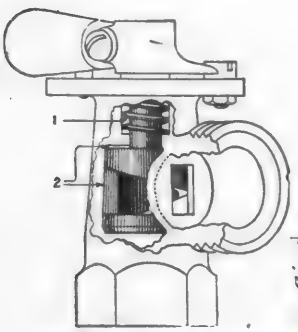


Fig. 3—Sectional View of Hutchison Packless Graduating Valve.

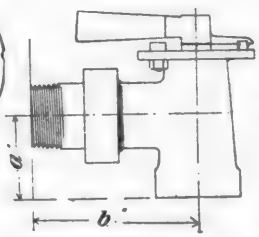


Fig. 4—Dimensions.

The radiators used should be of the water pipe tapped for top supply and bottom return, the return tapping being eccentric and either at the same or opposite end from the steam connection. Water radiators should never be tapped bottom supply. The size of the radiator tappings should be as indicated in Table IV.

TABLE IV.

Size of Radiator Square Feet.	Supply In. Diam.	Return In. Diam.
0-30	½	½
31-90	¾	½
91-180	1	½

The vapor being condensed in the radiator flows out along with the air through the union elbow on the return end and into the return mains which are vented to the atmosphere. The union elbow is shown in Fig. 5 and is made only in the ½-in. size, the dimensions being as indicated.

Continuing from the ½-in. return elbow (into which is screwed a ½-in. stub from which a ¾-in. horizontal pipe is used to connect to the riser) the return condensation and air follow down the return risers and mains back toward the boiler.

The returns are sized as shown in Table V.

TABLE V.

Nom. Size of Pipe. In. Diam.	Maximum Radiation Sq. Ft.	Maximum Hor. Length Feet.	Maximum Total Length Feet.
½	180	None	Stub
¾	500	25	100
1	900	40	100
1¼	1900	65	100
1½	3000	100	100
2	5200	125	125

Whenever it is necessary to exceed the length allowed in the above schedule the pipe is increased one size.

The condensation and air then return to the trap receiver, the air vent being connected just before the drop is made to the receiver. Here the regulator bulb is attached as illustrated in Fig. 6, the bulb consisting of a closed sphere connected by a flexible pipe to the trap receiver and by a small tube to the return line to serve as a relief pipe. Any increase of pressure in the boiler causes the water to back up from the trap receiver and flood the closed sphere; this so increases the weight of the sphere that it drops sufficiently to close the drafts by means of the chains to which the sphere is connected.

On the vapor pressure being reduced by the closing of the drafts the water flows

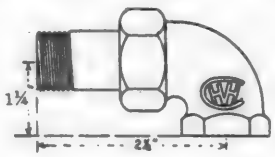


FIG. 5.—UNION ELBOW.

out of the sphere and returns to the receiver through the flexible pipe thus reducing the sphere's weight and allowing the counterspring to draw up the sphere together with its damper chains, thus again opening the drafts. The inlet and outlet of water from the sphere is made possible by means of a small flexible balance pipe previously mentioned as running from the top of the sphere to return pipe being connected thereto above the water line. This receiver also prevents the backing of water out of the boiler without the use of a check whenever any pressure is generated.

The size of the trap receiver should be No. 1¼ for boilers of 2500 sq. ft. or less and No. 2 for boilers of 2500 sq. ft. or over, these being tapped the same size as their respective numbers, while the damper regulator should be

No. 1¼ for boilers of 2500 sq. ft. or less and No. 2 for boilers of 2500 sq. ft. or over.

When radiators are located on the side walls only slightly above the water line the condensation may be returned direct to the boiler through a wet return provided the air is relieved back into the main return by a line which is not pocketed and which lies above the boiler water line throughout its entire length. Such wet returns should be sized as shown in Table VI.

TABLE VI.

Nom. Size of Pipe In. Diam.	Radiation Square Ft.	Maximum Length Ft.
1	1000	50
1¼	1800	75
1½	3600	125
2	6000	200

The vent line to the chimney is made as per Table VII.

TABLE VII

Nom. Size of Pipe In. Diam.	Boiler Capacity Square Feet Radiation
1	700 or less
1¼	700 to 1900
1½	1900 to 3000
2	3000 to 5000

The vent line must be carried up to a point at least 10 ft. above the level of the return line; this may be done either outside the chimney or inside the chimney. If the line is run inside it should be of galvanized iron pipe finished off at the top with a tee the vertical pipe entering the branch tapping so that the back of the tee will prevent the soot dropping down and clogging the vent. Plugs to permit cleaning out the vent line should be placed at all turns in the pipe.

The special safety valve is set at 8-oz. pressure and is of the pop, side-lever type, all parts being of brass except a malleable iron base. The various sizes of safety valve should be used on systems of the following capacity:

1-in. valve on 700 sq. ft. or less of radiation.

1¼-in. valve on 700 to 1200 sq. ft. or less of radiation.

1½-in. valve on 1200 to 2000 sq. ft. or less of radiation.

2-in. valve on 2000 to 3500 sq. ft. or less of radiation.

It is important to remember that all pipe sizes as herein listed are based on having the full area of the pipe and will not apply where pipes *are not reamed.* Where it is necessary to use an unusual number of fittings the pipe should be increased one size to reduce the friction as much as possible.

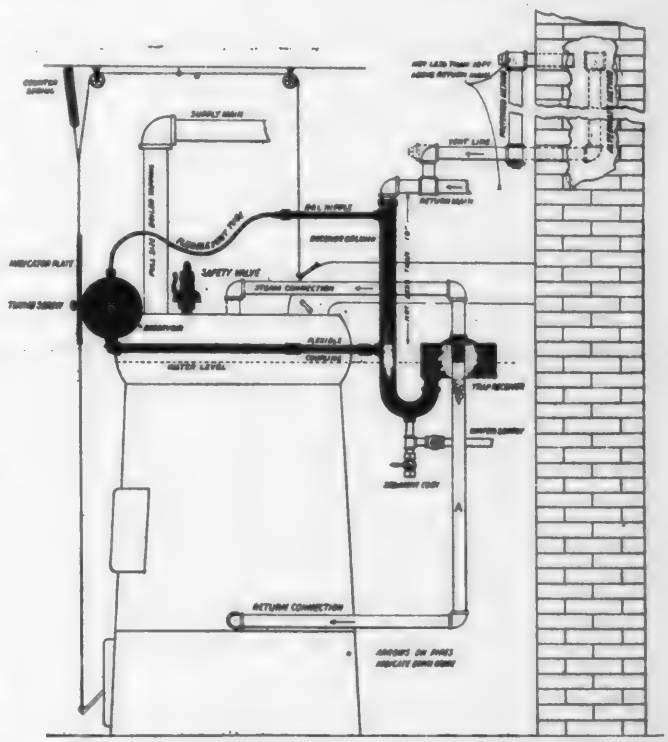


FIG. 6.—BOILER CONNECTIONS WITH HUTCHISON SYSTEM.

Wage Scales in the Building Trades.

Comparative figures showing how wages have advanced in every branch of construction during the past two years have been compiled for the Philadelphia district by the *Builders' Guide* of Philadelphia. The showing for the heating and allied trades is as follows:

Plumbers—1903, $4.25; 1904, $4.50; 1906, (February), $4.75; 1906, (Oct.), $5.00; 1910, $5.50; 1917 (July), $6.00. Agreement expires July 1, 1920.

Steam Fitters—1903, $4.50; 1906, $5.00; 1911, $5.50; 1917 (July), $6.00. Agreement expires Jan. 1, 1920.

Steam Fitters' Helpers—1903, $2.65; 1906, $3.00; 1917 (Apr.), $3.20; 1917 (July), $3.40. Agreement expires Jan. 1, 1920.

Roofers and Sheet Metal Workers—1903, $4.00; 1905, $4.50; 1910, $4.75; 1913, $5.00; 1918, $5.60.

The War and the Heating Engineer

Homes to Be Put on Fuel Rations.

According to an announcement of Harry A. Garfield United States Fuel Administrator, a rationing scheme has been drafted, based upon the so-called Philadelphia plan. In discussing the plan Mr. Garfield said:

"There will not be enough household coal available this winter if last year's waste continues or if unequal local distribution is not prevented.

"The fuel administration has taken the necessary steps to this end. Householders may be put on coal rations as in England and France. The coal allowed to each consumer will not be the amount used last year, but only so much as is scientifically found sufficient to heat his house to 68°, providing every conservation rule has been obeyed. The allowance for each will be sufficient for comfort, but the thoughtless and wasteful consumer who finds his allowance gone before the end of the winter will have only himself to thank if he has no fuel with which to heat his house.

"Under this system every one will get his fair proportion of coal. The hoarder will be eliminated. This system was originally worked out and applied in Philadelphia. It has proved an unqualified success and, with modifications suggested by the experiences in that city, the adoption and enforcement has been referred to the Federal fuel administration in all States.

CENSORSHIP OF ALL BINS.

"This plan involves a department of coal allotments in connection with each local fuel administrator's office. Plans for this organization and for the necessary equipment have been completed by the administration in Washington in such detail that the local bureaus can inaugurate the system without delay. The important features of the plan are:

"First, a censorship of every order for coal received by any dealer, each order being compared with a figure obtained by very simple yet effective formulas showing the rating of the house where the coal is to be used;

"Second, actual inspection of all doubtful cases and a checking up through inspectors of statements made by householders as to the coal on hand, the space to be heated and the heating system employed;

"Third, an effective refusal to furnish any householder more coal than a scientific analysis shows is necessary if the requisite care is taken in the heating of the house. Under this system surplus coal will be refused.

VIOLATORS TO BE PROSECUTED

"All consumers who have obtained a quantity of coal in excess of their allotments, or who by deceit or misrepresentations have violated any rules and regulations of the fuel administration, will be prosecuted."

The United States Fuel Administration has announced that allotment has been made to the State of New York of approximately 10% more anthracite coal this year, which should result in a substantial increase to each community and go far to avert the danger of a famine.

"With regard to the domestic situation in New York City," says the Fuel Administration, "you are advised that there is a steady movement of domestic anthracite now going into Greater New York, which is ahead of the previous year's shipments on a proportionate monthly basis. Distribution this year is following the lines of the coal year 1916-1917, or, in other words, the period from April 1, 1916, until March 31, 1917.

"During this period 7,160,344 tons of domestic sizes were shipped into Greater New York and 4,390,766 tons of No. 1 buckwheat or smaller sizes, which would mean an average monthly shipment of 596,695 tons of domestic.

"During April and May this year the figures are 1,225,524 domestic sizes and 699,998 smaller, or an average of 612,762 per month. Greater New York, on the basis of monthly shipments, is getting more domestic coal than formerly."

Coal-Distribution Plan.

In connection with the plans for the distribution of coal within the various States the War Industries Board will decide what consumers shall have preference in securing

coal, but the United States Fuel Administration has been asked to assist in the compilation of complete preference lists.

The crux of the new distribution plan lies in the compilation of these preference lists. All consumers of coal, except domestic consumers, will be recorded under the following classifications: (a) Railroads; (b) Army and Navy, together with other departments of the Federal Government; (c) State and county departments and institutions; (d) public utilities; (e) retail dealers; (f) manufacturing plants on War Industries Board's Preference List; (g) manufacturing plants not on War Industries Board's Preference List. The first six classes will be given preference in coal shipments in cooperation with the plans of the War Industries Board.

The list of consumers entitled to preference as established by the War Industries Board will be obtained through a questionnaire sent to every manufacturing plant in the country using more than 500 tons of coal annually. This list when compiled, will be furnished to each Fuel Administration District Representative in the producing field which supply the various States, and with these lists to guide them, together with weekly reports which will be required from each manufacturing plant, the State and local fuel administrators and district representatives will give their particular attention to building up proper stocks of coal at all essential war plants.

Under this plan of distribution each consumer should arrange for shipments from the same source of supply as last year, if possible.

Reports Wanted on "Enemy" Property.

Those who have reports or information on enemy-owned property in their vicinity are asked to communicate the facts at once to the Bureau of Investigation, Alien Property Custodian, Washington, D. C. About $750,000,000 worth of property has already been reported to Washington, but the custodian, A. Mitchell Palmer, states that there is undoubtedly much more to be located.

Administrative Engineers for Fuel Administration.

The list of administration engineers appointed to date by the United States Fuel Administration are:

Thomas R. Brown, Pittsburgh, for western half of Pennsylvania; formerly special engineer of Westinghouse Air Brake Co.

George R. Henderson, Philadelphia, for eastern half of Pennsylvania; formerly consulting engineer of Baldwin Locomotive Works.

Edward N. Trump, New York City, for State of New York; vice-president of Solvay Process Company.

W. R. C. Corson, Hartford, for New England; secretary, Hartford Steam Boiler Insurance Co.

Charles A. Cahill, Milwaukee, for Wisconsin.

As already announced in these columns, the national plan of the fuel administration provides for:

1. Personal inspection of every power plant in the country.

2. Classification and rating of every power plant, based upon the thoroughness with which each owner of said plant conforms to recommendations.

3. Responsibility of rating the plants will fall upon the administrative engineer in each State, the rating to be based upon the reports of inspectors, who will not express opinions, but collect definite information. The State fuel administrator, in his judgment, may entirely or partially shut off the supply of coal to any needlessly wasteful plant in his territory.

Frank C. Wagner, professor of mechanical engineering at Rose Polytechnic Institute, Terre Haute, Ind., has been appointed administrative engineer for the United States Fuel Administration for Indiana. In addition, Professor Wagner and Charles Brossman, consulting engineer, of Indianapolis, have been appointed by the fuel administration to take charge of special fuel conservation activities in Indiana industries. Mr. Brossman's duties will be limited to investigation of electric power plants in the State for the purpose of making recommendations for the consolidation of certain plants in order to save fuel.

In Charge of Power Plant Efficiency.

The United States Fuel Administration has appointed Henderson W. Knott to manage the field force of engineers and inspectors which is at work among the power plants of the country, carrying out a campaign of instruction and inspection designed to bring the use of fuel for the production of power to the highest possible efficiency and economy. Mr. Knott has been the general manager of the Morgan Crucible Company of New York City.

The appointment of Mr. Knott is a part of the plan, originated by David Moffat Myers, advisory fuel engineer of the Fuel Administration, to have each of the 250,000 steam plants in the United States visited by a competent man who can make suggestions and report in connection with the questionnaire originated by Mr. Myers, working with committees from the four great engineering societies. This work will naturally require a large number of inspectors devoting their time to traveling among the steam plants.

This field force will be organized by States in order to give it greater force and efficiency. Many of the State heads who work directely under the State Fuel Administrators have already been appointed and Mr. Knott, co-operating with Mr. Myers, will complete the list of State appointees. Mr. Knott will, at an early date, visit the States already organized to study the work being done by the men in the field, and to speed up the inspection program.

Need for Technically-Trained Persons in Patent Office.

Word has been received from J. S. Newton, commissioner of patents, that technically-trained persons are needed for the examining corps of the Patent Office. Men and women are desired who have a scientific education, particularly in higher mathematics, chemistry, physics, and French or German, and who are not subject to the draft for military service. Engineering or teaching experience in addition to the above is valued. The entrance salary is $1500. Examinations for assistant examiner will be held August 21 and 22. Full particulars may be obtained by writing to the Civil Service Commission, Washington, D. C., or to the U. S. Patent Office, Washington.

Trades Preparing for Fourth Liberty Loan.

The United States will next month call upon the men and women of this country to support a great government loan to aid in winning the war. The issue of bonds for the Fourth Liberty Loan will equal or exceed $6,000,000,000. The tentative date for opening the sale of the new certificates is September 28. It will continue about three weeks.

It has been stated that the nation's war programme will necessitate the expenditure of $24,000,000,000 during the fiscal year ending June 30, 1919. This money will be raised in two ways; by taxation and by the issue of bonds.

Taxes of all kinds added $4,000,000,000 to the nation's treasury during the past fiscal year, when total expenses were between twelve and thirteen billion dollars. We cannot contemplate doubling the national budget without increasing the tax income in the same ratio. Plans are now under way to make substantial additions to the amounts derived from war profits and personal incomes. Should these additions swell the tax returns to $8,000,000,000, there would still be left twice this amount to be raised by the sale of bonds.

Enormous as this sum appears on paper, it still barely scratches the surface of our national resources, which, as Thomas W. Lamont recently pointed out, were estimated at the beginning of the war at $250,000,000,000. The total amount derived from the sale of government securities to date is $9,978,785,800.

Appreciation of Work of New York State Commercial Bodies.

In General Orders No. 32, issued from the adjutant-general's office in Albany, N. Y., appreciation is expressed for the valuable assistance rendered by the commercial organization of the State in the recruiting and administration of the new military body known as the New York Guard, now numbering about 21,000 officers and enlisted men.

Heating Men in Military Service.

Wallace F. Goodnow, of the New York branch of the American Radiator Company, has been appointed a first lieutenant in the Construction Division of the Aviation Corps. Before his departure for Washington where he will be located indefinitely he was tendered a dinner at the Machinery Club, New York, by a number of friends including Willis H. Carrier, Arthur Ritter, Thomas N. Chester, Burt S. Harrison, Frank T. Chapman, David Beatty, George G. Schmidt, Charles A. Stevens, E. P. Heckel, E. A. Briner, E. Hilton and J. Barton Garfield.

Albert W. Hills, formerly western representative for the Haydenville Co., Haydenville, Mass., has been commissioned ensign in the navy. He is now stationed at an Atlantic port in charge of coaling ships in the transport service.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Research Committee Inspects Bureau of Mines Testing Station in Pittsburgh.

After approval had been given to the plans of the research committee of The American Society of Heating and Ventilating Engineers, in Buffalo, last June, which included the use of the testing station of the Bureau of Mines in Pittsburgh, a party, made up of members of the committee and others interested, visited Pittsburgh as guests of W. R. Talbot, superintendent of the Pittsburgh station. Included in the party were J. I. Lyle, chairman, J. D. Hoffman, Perry West and H. M. Hart.

An inspection of the facilities afforded by the government's plant for carrying on the research work of the heating engineers' society demonstrated to all that the station was in splendid shape to meet the requirements, being able to provide, in addition, the necessary office space, steam power, light and heat. The members came away enthusiastic over their inspection.

Plans for Advancement of Warm-Air Furnace Heating.

At the recent meeting of the National Warm Air Heating and Ventilating Association, held in Milwaukee, June 12, action was taken to provide for the testing of furnaces and appliances at the new testing station of the University of Illinois at Champaign. A resolution was also adopted urging all furnace manufacturers to voluntarily reduce their lines of furnaces to three styles and five sizes of each style, and to make no size of furnace smaller than a 19-in. firepot.

The testing station at the University of Illinois is so arranged that a furnace may be tested under as nearly actual working conditions as it is possible to obtain. It is really a building within a building, so that a furnace may be set up, with pipes running to the first and second floors. The first year's work, it is expected, will call for an expenditure of $8,000, and is to be borne by the association. The university reserves the right of publication of the data. It was decided that the first tests should be to determine the value of the furnace as a heater.

Dr. E. Vernon Hill, who was one of the speakers, said that the possibilities of ventilating a building are greater with a warm-air furnace than with any other type of heating system, because it provides a means of furnishing warm, moist, clean, moving, fresh air.

New officers were elected as follows:

President, W. G. Wise, Akron, O.; vice-president, John A. Howard, Dowagiac, Mich.; treasurer, I. L. Jones, Utica, N. Y.; secretary, Allen W. Williams, Columbus, O. Executive committee: John D. Green, Detroit; E. P. Miller, Marshalltown, Ia.; G. D. Wilkinson, Chicago; and W. L. Dawbarn, New York.

American Society of Mechanical Engineers.

The following nominations are announced for officers of The American Society of Mechanical Engineers:

For president, Dean Mortimer E. Cooley, Ann Arbor, Mich.

For vice-presidents, F. R. Low, New York; Henry B. Sargent, New Haven, Conn.; and John A. Stevens, Lowell, Mass.

For managers: Charles L. Newcomb, Holyoke, Mass.; F. O. Wells, Greenfield, Mass., and Dean C. R. Richards, Urbana, Ill.

For treasurer, William H. Wiley, New York.

National Organization of Building Industry.

As the result of a meeting of forty representatives of organizations in the building industry, held in New York, June 14, a resolution was adopted to appoint a committee to outline a plan for a proposed national organization of the building industry, first to place its resources at the disposition of the Government and, second, to continue during the war the production of permanent wealth to the largest extent practicable in view of war needs and for conserving the organization of the building industry in such manner that, upon the return of peace, the industry may be prepared as soon as possible to resume its normal activity.

In moving the adoption of the resolutions a letter was presented from President Harry A. Wheeler of the United States Chamber of Commerce in which he stated:

"It is the purpose of the War Service Executive Committee of the Chamber of Commerce of the United States to encourage by every means in its power the organization of all of the industries into trade associations, and to relate allied associations in such a manner that the industries can be completely represented with respect to their participation in war work, and with respect to the maintenance of foundations for carrying on the industry with as little interruption as possible during the period of the war.

"If the building industries generally over

the country can be brought together so that groups representing the industry at different cities will create a central committee for the study of the needs of the business, the Chamber of Commerce War Service Executive Committee will be very glad to study the problems with your central body and to exercise any influence it may possess in behalf of legitimate continuation of the building business even though it may not have to do with construction directly related to war purposes."

At a subsequent meeting of the organization committee it was voted that a convention be called for July 15 in Atlantic City, each association connected with the building industry to send one representative to serve, temporarily at least, on a central war service committee.

Over 225 representatives of regional associations of supply, engineering and contracting bodies and of individual manufacturing firms attended the Atlantic City meeting. After a full day's discussion the convention resolved to form the "National Federation of Building Industries," composed of members whose places of business are located or whose products are distributed at large over the United States. The federation is to be managed and its policies developed and carried out by a body of delegates to be known as the "Building War Service Committee."

The federation will be composed of two classes of membership: national, whose products are distributed at large over the United States; and regional, whose products are distributed principally in a city district, locality, State or region. The National Committee of Confederated Supply Association, for instance, comes within the scope of national membership and the Eastern Supply Association within the scope of regional membership.

The "War Service Committee" forms the personal contact between the Federation and the Government. A. M. Maddock, vice-president of the Eastern Supply Association, was elected to membership on the War Service Committee, representing the steam, plumbing and gas supply industries.

It is expected that the new National Federation of Building Industries will solve the great problem that the building industries have been grappling with since the war began, that of unifying the industry.

Speeding Up the Trade Extension Campaign.

At a meeting of the Trade Extension Committee, representing the heating and plumbing manufacturers, jobbers and contractors, in the movement for "Building Bigger Business," June 21, the committee was authorized to start an intensive campaign during the ensuing weeks in some given section, to be selected in accordance with the number of "premise report" cards received.

It was also voted to add to the committee a delegate representing the trade press and the trade papers co-operating in the campaign were authorized to elect such a delegate. James H. Heatherton, of the *Plumbers' Trade Journal*, was elected.

In the course of the discussion it was brought out that while the work is having the support of the manufacturers there is need for greater co-operation on the part of the jobbers.

At the afternon session it was proposed that all manufacturers' and jobbers' associations affiliated in the movement be invited to appoint a delegate and alternate to attend the meetings of the committee.

William J. Woolley presented a plan for enlarging the work of the Trade Extension Committee and making it a permanent adjunct of the trade. He proposed the establishment of a "business efficiency bureau," to be centrally located, to be in charge of a board of governors chosen by representatives of the various associations interested. This matter was referred to the finance committee.

The trade press was given a unanimous vote of thanks for its generosity in donating the series of four-page inserts in furthering the work of the Trade Extension Committee.

Central Station Town Heating Proposed for England.

Already, in England, the vast readjustment that must follow the close of the war is receiving wide attention, especially in engineering circles. A paper recently received from A. E. A. Edwards, of the firm of Edwards & Shaw, consulting engineers, of Birmingham, England, on the subject of "Steam Engines in Relation to the Fuel Economy Problem," gives an insight into the trend of English engineering thought.

The writer first calls attention to the fact that coal is England's most valuable asset and that, unlike other countries in handling their "capital," England is and has been exporting more than a quarter of its coal output each year.

He then refers to the report of the English "Coal Conservation Sub-Committee" with special reference to the committee proposal to divide Great Britain into sixteen districts and to put down central generating

stations at suitable points in which the by-products of the coal could be extracted before the coal or the gas from it is used for power production.

Mr. Edwards dwells at some length on the practice so prevalent in England of wasting the exhaust steam from power plants. Steam engine builders, he states, have taken infinite pains to reduce the consumption of steam in engines, from say 12 lbs. per horsepower to 11 lbs. This is a 9% reduction of coal, but it means that we are getting 9% efficiency out of the coal burned instead of 8% previously obtained. He then proceeds:

"My proposal is that, instead of turning 61% of heat into the condenser or blowing it into the atmosphere, we heat water at the station by condensing the steam at a low vacuum and pump this hot water round the district to form a heating and hot-water service." He calls attention to the wide use of this system in America and adds that it is employed in very many of the large institutions in England, but has never been applied to town heating except in Manchester, where the Electric Supply Company is now supplying exhaust steam for heat and hot water to several large blocks of buildings.

Mr. Edwards also refers to the possibilities of using such a plant in the summer time for making ice or refrigeration on the ammonia absorption system.

"Why aim," he adds, "at a grand elaboration of supply stations with their enormous cost, etc., when with a simpler plant right on the spot, you can get at least 36%, and with a thoroughly efficient plant, 49% efficiency?"

In the discussion that followed the reading of Mr. Edwards' paper it was pointed out by one speaker that the electrification of railways is closely wrapped up with the proposal to establish a number of super power stations and that this is of the greatest national importance at the present time. He endorsed, however, the scheme for establishing small generating stations in residential parts of the cities on the plan outlined by Mr. Edwards.

In the United States, according to E. W. Rice, Jr., in a recent issue of the *General Electrical Review,* where electricity has been substituted for steam in the operation of railroads, fully 50% increase in available capacity of existing tracks and other facilities has been demonstrated. It is estimated that something like 150,000,000 tons of coal were consumed by the railroads in the year 1917. It is now known, from the results from such electrical operation of railroads as we already have in this country, that it would be possible to save at least two-thirds of this coal if electric locomotives were substituted for the present steam locomotives. On this basis there would be a saving of over 100,000,000 tons of coal in one year. This is an amount three times as large as the total coal exported from the United States during 1917.

CORRESPONDENCE

Circulation in Pipe Coils.

EDITOR HEATING AND VENTILATING MAGAZINE:

Can you kindly answer the following questions which have been puzzling me?

An old forced hot-water installation is equipped with numerous horizontal return-bend pipe coils. These are constructed of 2-in. pipe, 15 high and about 16-ft. long, making a total of 240 lin. ft. of pipe. The coils are arranged horizontally. It is intended to convert the system into a vacuum system, with the supply in the top line and the return at the lower end with a trap.

First: Will the circulation be perfect with a coil of this size and height? Also what is the limit for return bend coils?

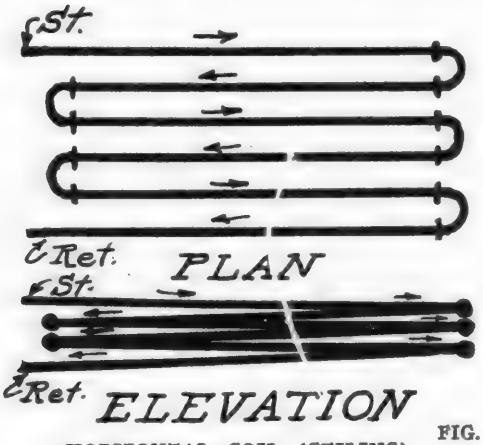
Second: Would it not be advantageous to change these coils to "miter-coils"?

Third: Can "bucket-type" traps be used satisfactorily without blowing steam into the returns?

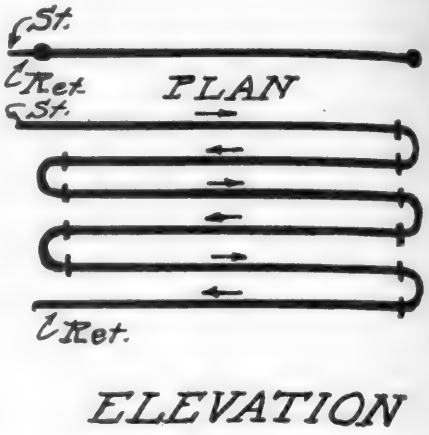
Chicago. A. W. H.

Our correspondent speaks of having "numerous horizontal coils . . . . . of 2-in. pipe 15 high." Also that he expects to convert the system to vacuum-steam "with the supply in the top line and the return at the lower end." We have always construed a "horizontal" coil as being one in which the pipes are all in the same horizontal plane, such as occurs in ceiling coils and a "vertical" coil as one where the pipes all lie in the same vertical plane, such as wall coil. It is difficult for us to know what the "top line" and "bottom end" would be in a flat ceiling coil unless our correspondent refers to the slight difference in elevation due to the pitch.

If wall coils are referred to (as we believe) there will be no trouble experienced in changing over to vacuum steam provided the coils pitch down continuously from the top inlet to the bottom outlet, as they should.



HORIZONTAL COIL (CEILING).



VERTICAL COIL (WALL).

FIG. 1.

With ceiling coils it is not likely that it would be practical to hang these so as to give a continuous pitch as each pipe in a return-bend coil would pitch in a different direction from the next two adjacent pipes and must run on a slightly different level. This is illustrated in Fig. 1 where both a wall and ceiling coil are shown, the direction of the proper pitch downward being indicated by arrows. If the coils *can* be pitched properly and continuously there is no reason why even a return-bend ceiling coil would not work perfectly.

So far as we can see, the only advantage of using a miter coil is that the steam travel would be reduced from 240 ft. to 16 ft. in each coil, thus saving 224 ft. of length. This might require—in some cases—a jumping of the steam main up one size in order to care for the longer travel, although if the steam pressure is to be carried at 3 to 5 lbs. gauge there need be no increase of size.

As far as bucket-type traps are concerned, they will cost six to eight times as much as a good thermostatic or water-seal valve and will not handle air. The only way such traps can be utilized is to connect them for handling the water only and by-pass them with an air line in which is placed a small thermostatic valve for air relief. This is illustrated in Fig. 2. We recommend using a standard radiator trap of proper size for such work as these are a true economy in the long run. The trap connection should be made as shown in Fig. 3, with a dirt pocket to prevent dirt and scale getting into the valve and causing trouble.

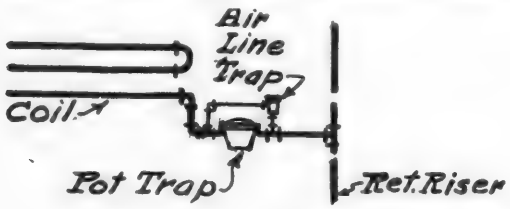


FIG. 2.—POT TRAP RETURN CONNECTION.

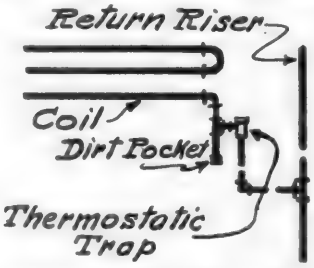


FIG. 3.—COMMON VACUUM RETURN CONNECTION.

Figuring Pipe Sizes for Steam, Water and Air.

EDITOR HEATING AND VENTILATING MAGAZINE:

In regard to your article published on page 51 of the January issue, please tell me how to figure pipe capacities, using friction. That is, if you have given the required capacity and the pressure, also the distance to be transmitted, how will you determine the pipe size for steam, water, and air.

Utica, N. Y. C. A. C., JR.

To figure pipe capacities, making an allowance for friction, the usual procedure is to consider four factors; these consist of the quantity to be delivered (Q), the length or run (L), the equivalent length of run (EL), the total drop allowable (D) and the size of pipe (d). Where the medium to be handled is compressible (such as steam or air) the pressure (P) must also be considered.

Since the pressure (P) does not enter into the calculation of pipe capacities for water this is the simplest of the three cases to consider. It must be remembered,

however, that all formulæ relating to the capacities of pipes are, at the best, only approximate. This is owing to so many variable factors being present; a formula correct for new clean pipe will not be correct at the end of several years when the pipe is more or less corroded and obstructed by dirt and scale; nor will a formula for pipe with the burr properly reamed out apply to a line where the pipe is installed unreamed; similarly common short-turn steam, air and water fittings will cut down the delivery of a pipe over what will be obtained with long-radius fittings and sweep tees, while pipe bends further increase the delivery by reducing the friction still more.

Tables are available in many reference books giving the loss due to friction for 100 ft. of run of straight pipe for various water deliveries in gallons per minute. These tables do not take fittings into consideration and the most practical method of handling the fittings is to reduce them to equivalent length of straight pipe. Thus a common 4-in. elbow handling a certain number of g.p.m. will produce a frictional effect equal to a certain number of feet of straight run of pipe without a fitting. This equivalent run for each fitting is then added to the length of the line (L) or actual length + equivalent length for each fitting × number of fittings = total equivalent length (EL).

For fittings one authority gives the following as the approximate length of straight pipe whose friction would equal the fitting:

Globe valves	= 60 pipe diameters
90° ells	= 40 pipe diameters
Return bends	= 80 pipe diameters

Gate valves and tees on the run may be neglected; tees on the branch may be considered as equivalent to an elbow; ells of 45° or 22½° are equal to about one-half and about one-quarter, respectively, of the length given for a 90° ell.

For the losses on straight pipe, use the tables of friction losses (based on Ellis and Howland's experiments) as given in Kidder's "Architects and Builders Pocket Book" and quoted in many manufacturers catalogs.

For example: To compute the size of pipe necessary to meet the conditions illustrated in Fig. 1, assuming the street main carries a pressure of 60 lbs., that the highest outlet on the pipe is 100 ft. above the main and that 10 lbs. pressure must be maintained on this outlet when the maximum flow of 50 gal. per minute (Q) is maintained.

Adding up the actual length of run (L) from the tee on the street main to the outlet gives

20
30
40
20
15
30
25
40
30
30
10
290 ft. actual length of run (L)

To this must be added

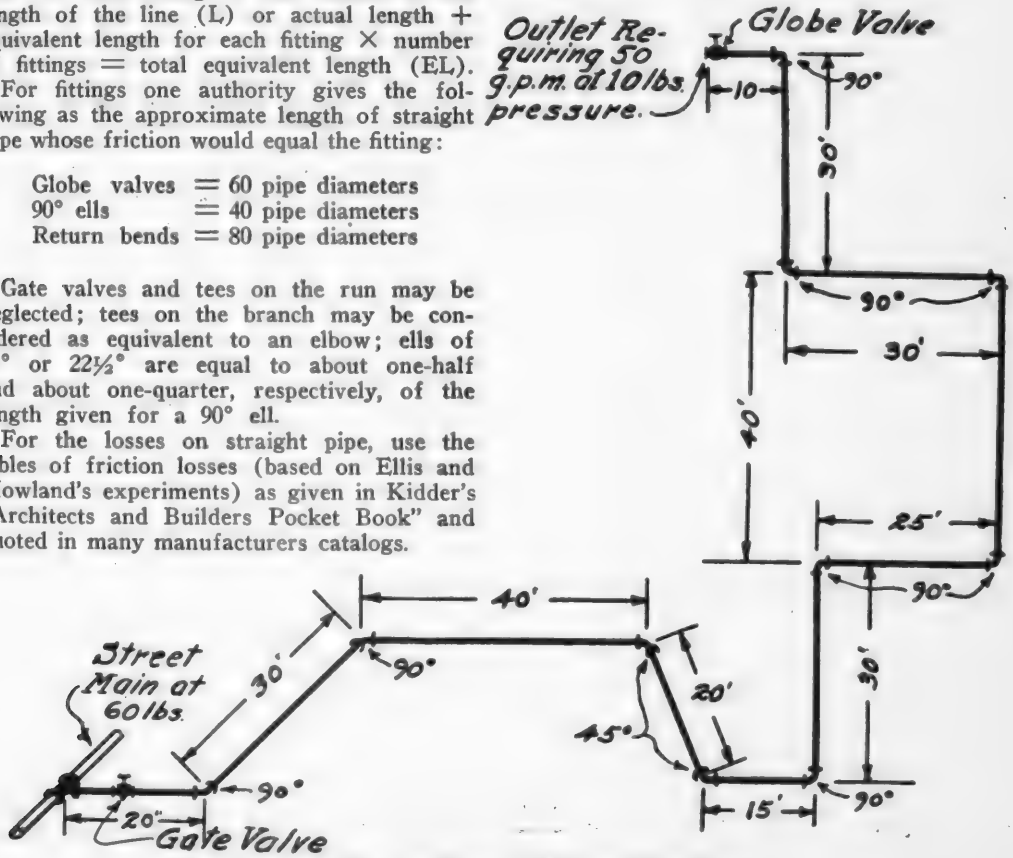


FIG. 1.—PIPING ASSUMED FOR CALCULATIONS.

1-tee on the branch
8 — 90° ells
9 × 40 diameters = 360 diameters.

2 — 45° ells
2 × 20 diameters = 40 diameters.

1 Globe valve
1 × 60 diameters = 60 diameters.

Total 460 diameters

So the equivalent length is equal to

290 ft. + 460 diameters.

If the street main maintains a pressure of 60 lbs. gauge and the rise is 100 ft., the hydraulic pressure at the outlet when no water is running will be

60 — (100 × 0.43 lbs.) = 60 — 43 = 17 lbs. As 10 lbs. must be maintained at the outlet when running 50 g.p.m. the friction drop in the line between the tee on the street main and the outlet must not exceed 17 — 10, or 7 lbs. As the total length of run is around 300 ft., this is a drop (D) of 7/3 = 2.3 lbs. per 100 ft.

Referring to the friction table previously mentioned it is found that for 50 g.p.m. the friction loss in 100 lin. ft. of pipe is

10. lbs. for 1½-in. pipe
2.44 lbs. for 2-in. pipe
0.81 lbs. for 2½-in. pipe

This shows that 2 in. is the correct size (without considering fittings) giving a total equivalent run of

$$290 \text{ ft.} + \left(460 \times \frac{2}{12}\right) \text{ or}$$

290 ft. + 77 = 367 ft. equivalent length (EL) with fittings. 7 lbs. total allowable friction ÷ $\frac{367}{100}$ = 1.9 lbs. per 100 ft. allowable friction drop (D). Since the friction on 2-in. pipe is 2.44 and is for clean pipe only, 2½-in. pipe would be the proper size to use, this giving

$$290 + \left(460 \times \frac{2\frac{1}{2}}{12}\right) =$$

290 + 96 ..... = 386 ft. equivalent length (EL) 7 lbs. total allowable friction ÷ $\frac{386}{100}$ = 1.8 lbs. per 100-ft. drop (D) allowable against 0.81 actual on 2½-in. pipe. Therefore, this is the correct size under the conditions named.

The discussion of the various formulæ developed for determining the flow of steam in pipes is too great a subject to be entered into here, but as most of these formulæ have been computed for various conditions the easiest way to obtain the approximate discharge of a steam pipe is by use of some table calculated from a reliable formula.

Table 66 and 67 in Babcock and Wilcox's book "Steam" will probably help our correspondent, one of the tables being calculated for pipes 240 diameters in length at various pressures and 1 lb. drop, while the other is based on pipes 1,000 ft. long at various drops and pressures.

The same pipe illustrated in Fig. 1 may be taken as an example for steam to avoid calculating another line. Assuming the main carries steam at 111 lbs. gauge, or 126 lbs. absolute pressure, and that 50 lbs. of steam per minute (Q) at 109 lbs. gauge, or 124 lbs. absolute pressure, are required at the outlet. Then the allowable drop is 126 — 124 = 2 lbs. for about 300 ft. of run, or 0.66 lbs. per 100 ft., or 6.6 lbs. drop for 1,000 ft.

Referring to the Table 67 mentioned it is seen that at 6.6 lbs. drop 125 lbs. (average absolute pressure in line) steam will require between a 3-in. and a 4-in. pipe.

Then to re-calculate accurately, the total equivalent length of run is 290 + 460 × 4/12 = 443 lin. ft.

2 lbs. ÷ 443/1000 = 4.5 lbs. drop per 1,000 ft.

Referring again to Table 67, it is found that, at 125 lbs. absolute average pressure and 4.33 lbs. drop per 1,000 ft., the delivery for a 3 in. pipe is 31.9 lbs. of steam per minute and, for a 4-in. pipe, 70.6 lbs. per minute. Therefore, 4 in. is the correct size or, possibly, 3½ in., if such pipe is obtainable.

It must be remembered that in very long runs of steam pipe the factor of condensation enters to a considerable degree. This is not so noticeable in larger lines because the condensation constitutes relatively such a small proportion of the total steam handled. On the smaller sizes it must be carefully considered as it is not at all impossible to decide on a small pipe which, on the basis of friction drop, delivery, etc. would be large enough for the purpose yet which might condense all, or nearly all, the steam before the other end is reached. This can only be allowed for by approximating such

radiation losses and increasing the delivery into the pipe by an equal amount.

With compressed air no condensation need be considered and, according to a formula published in the *American Machinist* by J. E. Johnson, Jr., Table 9, p. 48, in Harding and Willard's book on "Heating and Ventilation" has been computed, this table being based on $P_1^2 - P_2^2$ in which P_1 is the initial absolute air pressure in pounds per square inch and P_2 the absolute terminal pressure.

Taking the same pipe line as given in Fig. 1 and figuring for the same delivery in cubic feet of air as was used for steam with the same pressures and drop, the problem becomes:

50 lbs. of steam per min. @ 125 lbs. abs. pressure = 50 × 3.6 cu. ft. = 180 c.f.m.

To reduce this to free air $V_1 : V_2 :: P_2 : P_1$ or $V_1 : 180 :: 125 : 15$

$180 \times 125/15 = V_1 = 1{,}500$ c.f.m. of free air.

Since the initial pressure is 126 lbs. abs. and the terminal pressure 124 lbs. abs.

$P_1^2 - P_2^2 =$

$126^2 - 124^2 = 15{,}826 - 15{,}376 = 500$

$$500 \div \frac{300}{100} \text{ length of run} = 166 \text{ per } 100 \text{ feet.}$$

According to Table 9, a 3½-in. pipe for 1,500 cu. ft. will give a difference of $P_1^2 - P_2^2$, as 214.2 or more drop than allowable, while a 4-in. pipe shows 109.9, or less drop than permissible. Assuming a 4-in. pipe is correct, then the total equivalent length (EL) becomes the same for steam (443 ft.) or

Then $126^2 - 124^2 = 500$

$$500 \div \frac{443}{100} = 113 \text{ per } 100 \text{ ft. difference}$$

of squares.

As a 4-in. pipe has drop enough to give only 109.9 difference in squares it is just on the safe side.

New Publications.

SHEET METAL WORKERS' MANUAL, by L. Broemel and Professor J. S. Dougherty of the Carnegie Institute of Technology, Pittsburgh, is the title of a new work which takes up both elementary and advanced sheet metal work. A chapter is devoted to sheet-metal working machine and tool construction, explaining their application and uses. The book comprises fifteen chapters and has over 400 illustrations. Price $2.00. Published by Peck, Stow & Wilcox, Southington, Conn.

ESSENTIALS OF SHEET METAL WORK AND PATTERN DRAFTING, is one of the new books, being especially written for teachers and students and described as a reply by the pioneer manufacturer in the sheet and metal machine and tool industry to numerous requests for information regarding classroom work suitable for grade and high schools. The author is J. S. Dougherty, instructor in sheet metal work in the School of Applied Industries, Carnegie Institute of Technology, Pittsburgh. Price $1.50. Published by Peck, Stow & Wilcox Co., Southington, Conn.

EFFECTS OF MOISTURE ON THE SPONTANEOUS HEATING OF STORED COAL, by S. H. Katz and H. C. Porter is the title of a recent technical paper issued by the Bureau of Mines, Pp. 25, 9 illustrations. It is listed as Technical Paper No. 172.

WEIGHTS OF VARIOUS COALS, by S. B. Flagg, are given in Technical Paper No. 184, recently issued by the Bureau of Mines. Many different kinds of coal have been tested and analyzed by the Bureau of Mines in the course of its investigations relating to the purchase and use of fuel by the Government. Advantage has been taken of the opportunity thus afforded to obtain information as to the differences in weight of the different varieties. Pp. 11.

PIPE AND THE PUBLIC WELFARE is the title of a book of unusual interest written by R. C. McWane, manager of the Cast-Iron Pipe Publicity Bureau, New York. The text is largely historical, taking up, among other things, the early uses of pipe from the time of the Delhi Pillar to its first uses in France, London and the United States. Another chapter is devoted to the materials and methods of making metal pipe. The deterioration of metal pipe is discussed on the basis of many actual experiences. A separate chapter is given over to wood pipe. Much of the interest of the book is to be found in the popular style in which the book is written and in the illustrations which are numerous and carefully chosen. The author makes out a strong case for the lasting qualities of cast-iron pipe, especially as to its resistance to rust. On this subject he states: "It will be noted that cast-iron has a distinct granular or crystalline structure, a form common to all metals having undergone the simple prosess of smelting and cooling, which was one of the processes of Nature in the formation of the ore, and it is this distinctive structure, in combination with the chemical, or electro-chemical, action taking place on the surface of the metal, which serves to stop

that action, after it has proceeded to a certain depth, and hold the result (ferrous oxide) as a permanent, oxygen-excluding protective coating. This stoppage of rust action results from the fact that the crystals, or granules, in cast-iron are bound together at one or more points by a metallic bond, or bonds, and after a rust coating has been formed of the loose crystals on and near the surface of the metal, and the oxide penetrates between the crystals more strongly bound together, the force exerted by the absorption of moisture is not sufficient to separate the crystals, and the oxide remains as a permanent coating." Size 5x7¾ in. Pp. 165. Price $2.00.

A HANDBOOK ON PIPING, by Carl L. Svensen, B. S., assistant professor of engineering drawing in the Ohio State University, is one of the new books of the year which will be found a valuable addition to the heating engineers' library, although the scope of the book takes in practically every use of pipe. Following a historical discussion, chapters are devoted to dimensions and strength of pipe, pipe threads, pipe fittings and pipe joints. These are followed by chapters on standard and special valves. Under "Steam Piping" the matter of design is treated at length, with notes on the ring and duplicate systems, steam loop, etc. Piping for heating systems has a chapter to itself and covers both independent and central station systems. Size 6 x 9 in. Pp. 359, indexed and accompanied by eight large plates of piping layouts and 359 other illustrations. Price $4.00 net. Published by D. Van Nostrand Co., New York, and may be had through the book department of The Heating and Ventilating Magazine.

A STUDY OF THE HEAT TRANSMISSION OF BUILDING MATERIALS is the subject of a valuable bulletin (No. 102) issued by the Engineering Experiment Station of the University of Illinois. The authors are A. C. Willard, Professor of heating and ventilation at the university, and L. C. Lichty, research fellow, of the Engineering Experiment Station. A fuller report of the series of tests on which the study is based will be presented in a later issue of THE HEATING AND VENTILATING MAGAZINE. For the present it will be sufficient to say that the tests were made with the so-called "hot air box" method in which the box is made entirely of the material to be tested. Heat was supplied by electrical means. The amount usually operated through the material was determined from the combined electrical input to the heater and to the fan motor. The tests cover both still air and moving air conditions. Their extent and the care with which they were made will no doubt give them rank as one of the classical series of experiments made in this field. While the results do not vary greatly from those of previous tests some important items are brought out, such as the fact that a variation in the air velocity over the surface affects both the air-to-air coefficient and the outside surface coefficient. Also, the effect of the relative humidity of the air on the heat transmission of an ordinary wall is so small that it can safely be neglected in determining the total heat loss from a building. Finally it is brought out that air-space construction is of value at low temperatures, but not at high temperatures. Size 6 x 9 in. Pp. 56.

MAXIMUM PRICES OF COKE, with modification showing dates when effective, corrected to April 1, 1918, has been published by the United States Fuel Administration (Publication No. 24).

CARRIER AIR DRYING SYSTEM, as applied to the paper manufacturing plant of the Certainteed Products Co., Niagara Falls, N. Y., is presented in a carefully-prepared engineering circular by the Carrier Engineering Corporation, New York. While working on 50-lb. felt for the company's 2-ply Certainteed roofing, 20-min. runs were made with and without the Carrier system in operation and with felt coming off the machines equally dry in both instances. With the Carrier system and air in its ducts at a temperature of 160° F., 100 ft. of felt per minute were run off with a total weight of 1025 lbs. for the 20 minutes. Without the Carrier system the production was 88 ft. per minute, with a total of 890 lbs. for the 20 minutes. While the air-drying system was in operation 55% of moisture was present in the air surrounding the machine. Without it, the percentage ran up to 83. The production increase was 15.1%. On other pages of the circular the installation is described in detail, accompanied by photographs giving the reader a very clear idea of the operation of the system for this class of work.

Deaths.

Charles F. Belcher, treasurer of the Walker & Pratt Mfg. Co., Boston, Mass., died at his home in that city, July 8. He had been connected with the company since 1874.

Trade Literature.

INTERNATIONAL ECONOMY BOILERS, "tested and rated in accordance with the code adopted by the American Society of Heating and Ventilating Engineers," are presented in a new engineering catalogue, issued by the International Heater Co., Utica, N. Y. The catalogue will be found of special interest to the heating engineer on account of its frank and intelligent discussion of the principles of design of the Economy boilers and their various parts. The heating engineers' boiler code is given warm approval in the catalogue and a separate publication on the company's testing plant shows how closely the company has followed the code as set forth, with one exception, that of separating the ash from the unburned coal in the residual. The company's engineering department states that this was given up as impractical and as not nearly so accurate as the coal analysis. It is suggested that a dry steam tests might be included in the code at a future meeting of the society. Size of catalogue 6 x 9 in. (standard). Pp. 24. The International Heater Company has also issued a timely circular on "Best Ways to Run a Boiler," being a book of simple rules for steam and water boilers. A copy, it is stated, is shipped with each boiler.

ICE AND FROST is the title of a unique catalogue and house journal published by the Frick Co., Waynesboro, Pa. The current issue (Series A, No. 4) is devoted especially to small refrigerating plants and some of their uses, suitable for clubhouses and private dwellings, chocolate and candy factories, small hotels, and apartment houses. The system illustrated is the direct-expansion system in which the necessity of additional power for forcing brine through the cooling pipes is eliminated. Several types of the company's line of compressors are shown, as well as closed-flow and open-flow ammonia condensers. These are accompanied by typical complete installations for a variety of uses. Size 6 x 9 in. Pp. 34.

ILLINOIS THERMO, described as the "super trap" for vacuum, vapor and modulating systems, are featured in a new booklet issued by the Illinois Engineering Co., Chicago, Ill. Special attention is called to the vertical seat of this trap so that dirt does not lodge or lie on it. Attention is also called to the fact that the diaphragm closes against the steam and not in the steam, so that it does not have to wait until the water condenses in the radiator and cools off before opening. The diaphragm is made with concave sides to give flexibility without strain on the diaphragm. It has a ball and cone seat. The trap is made of phosphor bronze of 90,000 lbs. tensile strength and the bodies are of steam brass. The same circular shows the Illinois modulating supply valve, of the quick-opening type, lever-handles.

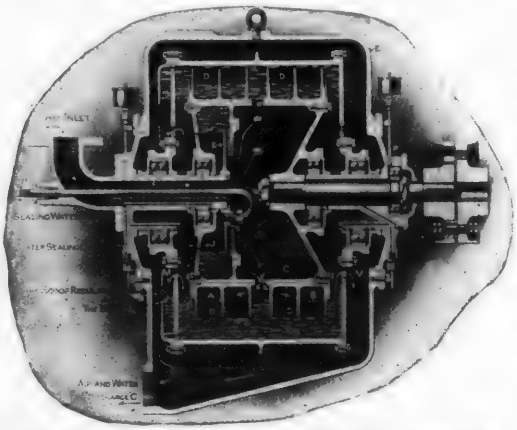
TYCOS MINERAL OIL TABLETS, giving their gravity and temperature from determinations of the Bureau of Standards, and other tables for general testing and refinery practice, compiled and edited by E. N. Hurlburt, are published in cloth covers by the Taylor Instrument Companies, Rochester, N. Y. The tables are fully indexed. Size 4¾ x 6½ in. Pp. 204. Price $1.00.

BUFFALO FORGES of the portable type, are illustrated and described in a new catalogue (Section 100) issued by the Buffalo Forge Co., Buffalo, N. Y. Attention is called to the fact that Buffalo forges have been on the market for 40 years and the extensive line shown in the catalogue attests the wide field covered by this department of the company. Size 5 x 7½ in. Pp. 112.

MARVEL TEMPERATURE REGULATORS, described as the first and only all electric clock, thermostat and motor, is featured in a blanket circular issued by the American Thermostat Co., Newark, N. J. Aside from the nightly adjustment of the thermostat to reduce temperature to the sleeping hours' standard, and the one setting of the clock to indicate the morning hour at which increased warmth is desired, the all-electric Marvel, it is stated, requires no attention from the householder; the clock winds itself once every 60 seconds. Other specialties made by the company and shown in the circular are the Marvel motor valve for radiator and valve control and the Marvel hot water thermostat for circulating hot water systems. The Marvel motor valve consists of a Gorton-type quarter-turn packless cone valve, to the post of which is directly connected the master Marvel valve motor, non-reversing and universal, operating on either alternating or direct current of 110 volts. Where steam or hot water circulating is constant, it is possible with this device to control individual radiator units or a connected system of units.

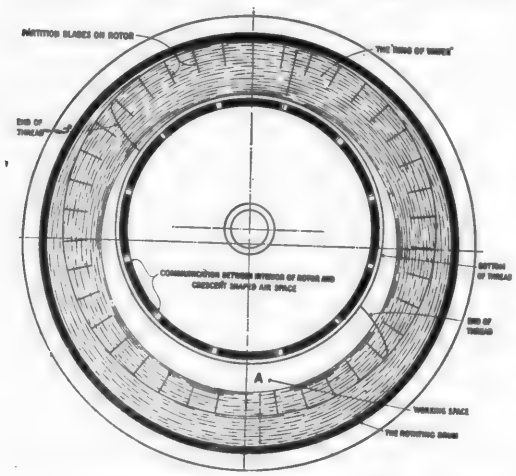
GLOBE-JOHNSTON ROTARY VACUUM PUMP AND CONDENSER, described as applicable to practically every process where vacuum or low-pressure compressed air is required, has been brought out by the Globe Pneumatic Engineering Co., Ltd., 1 Victoria St., London, S.W. 1, and is described in

great detail in a catalogue recently received from this company. This unit is featured as truly a rotary pump and truly valveless. It consists of two main parts, the rotor and the drum. The rotor is a hollow member on the outer circumference of which deep double-thread screws are formed. A passage runs between the twin-screw threads into the interior of the rotor. When the machine is producing a vacuum this passage acts as an inlet to the screw-threads, but when air



THE GLOBE JOHNSTON ROTARY VACUUM PUMP.

is being compressed it is the outlet. Similarly the pipe running from the interior of the rotor to the exterior of the machine is the inlet pipe in the vacuum pump and the outlet pipe in the compressor. The screw threads are joined by a large number of narrow partitions or blades which are equally spaced around the periphery of the rotor. The outer and inner edges of these blades are repeatedly flush with the top of the

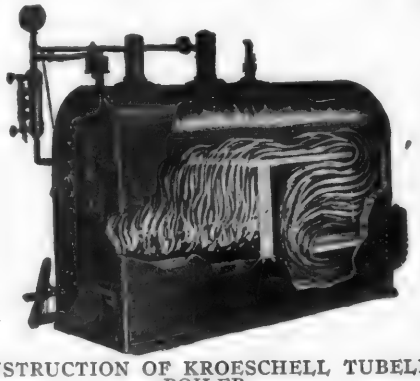


DIAGRAMMATIC SECTION, SHOWING "RING OF WATER."

screw-threads and half way down the depth of the threads. A ring of water is, in the first place set up by the action of these blades in conjunction with centrifugal force. Annular rings, called shrouding plates, fitted to the sides of the rotor and reaching somewhat below the water level on the discharge side, prevent the exhausted or compressed air returning along the screws when the thread ends leave the water-seal. The rotor is coupled direct to the shaft and is carried on massive self-aligning ball-bearings.

The holes in the side of the drum act as discharge and inlet openings for vacuum pump and compressor, respectively. The drum when rotating, contains the "ring of water," and is set eccentrically to the rotor. The relative eccentricity of the rotor and water ring produces what is called the working space. Other details of the pump include a scoop chamber and scoop for maintaining the correct depth in the ring of water, and a water-seal which is merely a substitute for a stuffing-box. Size of catalogue 7¼ x 9¾ in. Pp. 32.

KROESCHELL TUBELESS BOIERS for steam, hot water, vapor or vacuum heating systems, described as something entirely new in heating boilers, are presented in a new circular issued by Kroeschell Bros. Co., Chicago, Ill. This



CONSTRUCTION OF KROESCHELL TUBELESS BOILER.

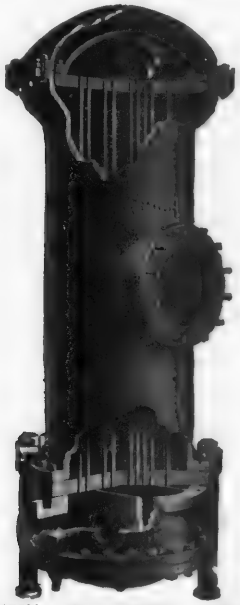
boiler is built in one piece, with a long-downward fire travel. It is also described as having self-cleaning direct fire surface. In connection with the circulation, the manufacturers state that this boiler contains less water than any boiler of equal capacity and that this, with the upward circulation of this small body of water in the thin waterways, insures most rapid heat transference. Any kind of fuel can be used, including hard or soft coal, wood, gas or oil. Another feature mentioned is that the boiler requires no assembling of parts but is shipped set up com-

plete. The boiler is furnished up to 3000 sq. ft. radiation capacity in the steam sizes and up to 4000 sq. ft. in the water sizes.

A Floating-Head Service Heater.

A floating-head service heater of the instantaneous water-tube type is a new product manufactured under the name of "Wainwright" by the Alberger Pump & Condenser Co., New York. The water flows through the several passes of tubes and the steam around the tubes. Due to the high rate of heat transmission obtainable by this arrangement, the design permits the use of a smaller heater, thus reducing the space requirements, as well as the initial and installation costs of the apparatus.

The shell, tube-heads, water channel and covers are made of cast-iron, assuring least possibility of corrosion, and, as the brass tubes are straight and smooth, the friction loss is reduced to a minimum. Frequent temperature expansion of the tubes, due to intermittent service, is taken up by the floating head so designed to eliminate the possibility of tube breakage. The use of water channel permits of ready access for cleaning without breaking of any pipe connection, and also permits convenient tube replacement in the event of accident. Straight tubes also



WAINWRIGHT FLOATING HEAD SERVICE HEATER.

avoid the necessity of removing any but the damaged tubes in case of replacement.

The Wainwright floating-head service heater, it is stated, can be furnished for any capacity and temperature requirements and can be designed to heat the water to within 5° of the temperature of either the exhaust steam or live steam available, if required.

Jas. P. Marsh & Company in Fifty-third Year of Business.

Jas. P. Marsh & Company, Chicago, Ill., have entered their fifty-third year in the manufacture of gauges, valves and traps. The company specialties are in use the world over and the firm has a reputation of being originators, as well as pioneer manufacturers.

Three separate catalogues have recently been published embracing the company's ex-

RECENT MARSH CATALOGUES.

ensive line. Catalogue No. 52V is devoted to the line of Marsh automatic air valves, Marsh air line valves, Marsh radiator traps, and incidental heating specialties. Catalogue No. 52G covers the complete assortment of Marsh standard and special indicating and recording gauges; also kindred instruments, including indicating and recording thermometers. Catalogue No. 52 is a general catalogue combining in one book the complete line of Marsh gauges, valves, traps and steam specialties. Copies of these catalogues may be had on request.

Scrap Iron Needed by Mills.

The iron and steel trade is calling attention to the importance of turning in scrap iron for which the demand at the mills is exceedingly heavy at the present time. All who have scrap iron under their control are urged to market it at the first opportunity. It is stated that the odd lots to be found all over the country would make a tremendous total.

Index of Standard Heating and Ventilating Data Sheets.

Included in the accompanying index of Standard Heating and Ventilating Data Sheets are those published during the past half year. In future it is planned to publish the complete index every six months.

Extra copies of any of the data sheets, printed on one side only, may be had at 5 cents each, or $2.00 for a year's supply of 48 sheets. Attention is also called to the fact that a special binder is provided for these Data Sheets, which will be mailed to any address on receipt of the price, $1.00. The binders are suitably stamped and are made especially to hold the Data Sheets.

No.	Date Issued	Subject
		B.T.U. Losses
1	Feb., 1917	General.
1-A	" "	Brick.
1-B	" "	Stone and Concrete.
1-C	" "	Combinations.
1-D	March, "	Tile.
1-E	" "	Frame Construction.
1-F	" "	Glass, Skylight and Miscellaneous.
1-G	" "	Ceiling, Floor and Roof.
		Exposure
2	April, 1917	General.
		Leakage
3	April, 1917	General.
		Temperature Range
4	April, 1917	Minimum Temperatures in U. S.
4-A	" "	Minimum Temperatures in U. S. (continued).
		Computing Heat Losses
5	May, 1917	General.
5-A	" "	Example.
		Ventilation
7	May, 1917	General.
		Air Changes
8	May, 1917	Churches and Theatres.
8-A	June, "	Hospitals.
8-B	" "	Hotels and Libraries.
8-C	" "	Schools.
8-D	" "	Miscellaneous.
		Properties of Air
9	July, 1917	Tables.
		Ducts and Flues
10	July, 1917	General.
10-A	" "	Elbows.
10-B	" "	Anemometer Readings.
10-C	August, "	Underwriters' Rules.
10-D	" "	Underwriters' Rules (continued).
10-E	" "	Underwriters' Rules (continued).
10-F	" "	Velocities Recommended.
10-G	Sept., "	Vent Flue Velocities.
10-H	" "	Areas of Pipes.
10-I	" "	Areas of Pipes (continued).
10-J	" "	Pipe Capacities at Various Velocities.
10-K	April, 1918.	Weight of Sheet Metal Pipes.
10-L	April, 1918.	Factors to Change Gauge.
10-M	April, 1918.	Sizing Ducts and Flues—First Method.
10-N	April, 1918.	Sizing Ducts and Flues—Second Method.
10-O	May, 1918.	Sizing Ducts and Flues—Third Method.
10-P	May, 1918.	Sizing Ducts and Flues—Third Method (Cont'd).
10-Q	May, 1918.	Sizing Ducts and Flues—Fourth Method.
10-R	July, 1918.	Sizing Ducts and Flues—Fifth Method.
10-S	July, 1918.	Sizing Ducts and Flues—Fifth Mehtod (Cont'd).
		Duct and Flue Details
11-A	Feb., 1918	Flue Outlets and Dampers.
11-B	" "	Details of Reversing Dampers.
		Symbols.
12	March, 1918.	Heating and Ventilating Symbols.
		Radiation
13	Jan., 1918	Radiation Computing.
13-A	" "	Radiation Efficiencies.
13-C	" "	Radiation Computing—Example.
		Radiators
14-A	Jan., 1918	American 1-Col. Rococo.
14-B	Feb., "	American 2-Col. Rococo.
14-C	" "	American 3-Col. Rococo.
14-D	March, 1918.	American 4-Col. Rococo.
28-G	May, 1918.	H. B. Smith Co.'s 1-Col. Princess.
28-H	July, 1918.	H. B. Smith Co.'s 2-Col. Princess.
28-I	July, 1918.	H. B. Smith Co.'s 3-Col. Princess.
		Chimneys
100	Oct., 1917.	General.
100-A	" "	Residence.
100-B	" "	Residence (continued).
100-C	" "	Coal and Air per B.H.P.
100-D	Nov., "	Draft Loss in Fire and Boiler.
100-E	" "	Draft, Theoretical and Effectual.
100-F	" "	Draft, Theoretical, of Stacks.
100-G	" "	Friction Losses in Steel Stacks.
100-H	Dec., "	Friction Losses in Brick Stacks.
100-I	" "	Summary and Draft Reading.
100-J	" "	Example of Computation.
100-K	" "	Costs.
		Fittings.
107	June, 1918.	Rules for 1915 Std. Wt. Flanged Fittings.
107-A	June, 1918.	Std. Wt. Pipe Flanges and Bolts.
107-B	June, 1918.	Std. Wt. Elbows and Reducers, Flanged.
107-C	June, 1918.	Std. Wt. Straight Tee Crosses and Laterals, Flanged.
		Exhauster Systems.
169-E	March, 1918.	Exhauster Systems—Weight of Sheet Metal Pipes.
169-F	March, 1918.	Factors to Change Gauge.

Danger of Error in Short-Period Tests.

"A man breathes sixteen times in a minute. It is not enough to prove that the air he breathes in once will not harm him, nor that sixteen breaths of it will not harm him, nor the 960 breaths in an hour, nor the 23,040 breaths in a day.

We note that actually a man may go for a month or three, or a year or ten, without seeming to be harmed by bad air, and then may begin to get pale, crotchety, out of sorts, or actually ill. Or, again, a man may go along in good shape for three months and then catch a cold or measles or pneumonia. All of these things may happen and foul air be the most important factor in causing them, even though it has been proven that men are comfortable and well as a rule for an hour a day or a week in four air, provided it is kept right as to temperature, humidity, and movement.

"It is somewhat like drinking milk. The harmful milk for babies in summer is that which looks, tastes, and smells all right, that which on analysis seems to be passable at any rate.—Dr. W. A. Evans in the *Chicago Tribune.*

SIZING DUCTS AND FLUES.
METHOD NO. 6

NOTE—For explanation and example assumed see Standard Data Sheets Nos. 10-M and 10-N.

The Buffalo Forge Co. utilizes two methods for sizing ducts and flues, one system for industrial work and another for public buildings.

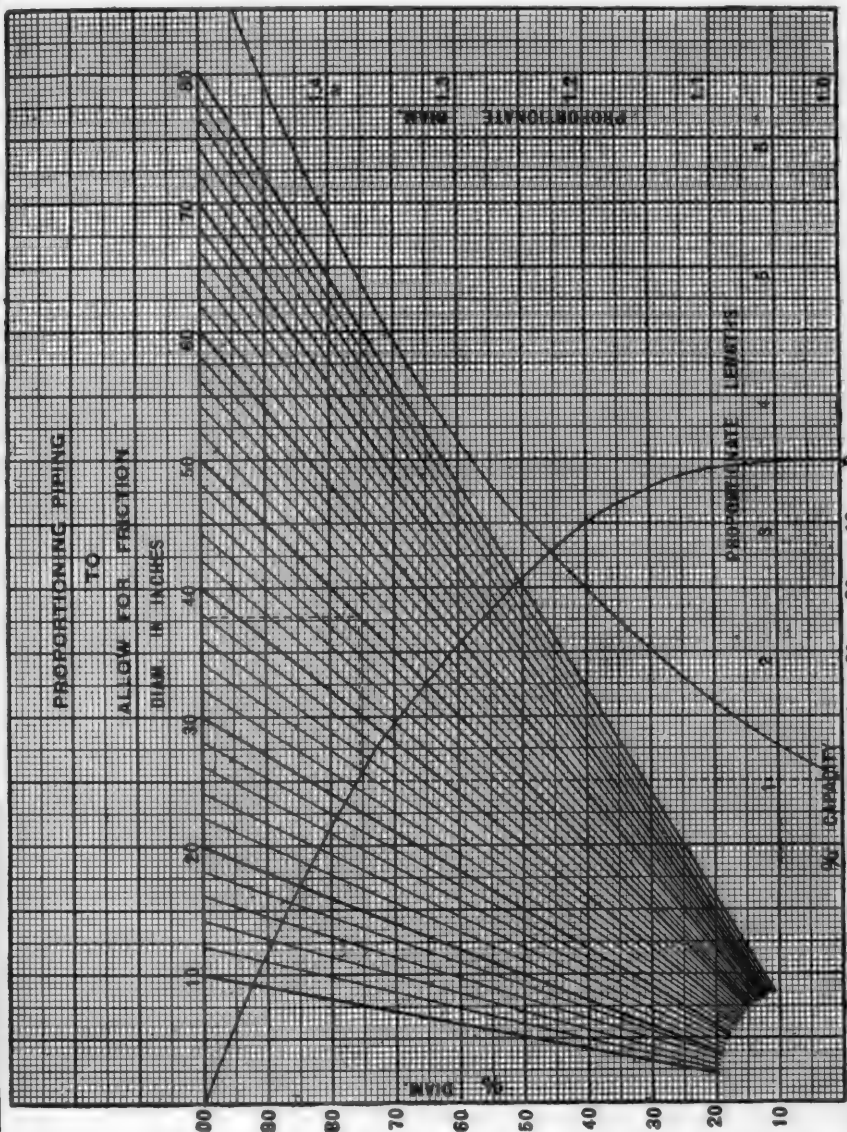


FIG. 1.—CHART FOR FIGURING DUCT AND FLUE SIZES ACCORDING TO METHOD NO. 6

DUCTS AND FLUES—SIZING—SIXTH METHOD. | No. 10-T.

SIZING DUCTS AND FLUES
METHOD NO. 6—Continued.

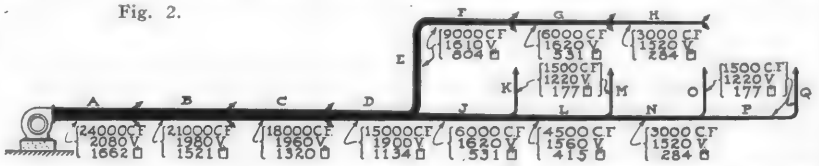
In public building work, individual ducts are recommended similar to those described in Method No. 2. For industrial buildings the sizing is developed from a chart which gives a constant friction drop in all lines regardless of size.

To use the chart, shown in Fig. 1, it is only necessary to determine the percentage of air delivered to each outlet and carried by each duct, together with the size of duct at the fan outlet; the sizes can then be read directly from the chart as follows:—

In the typical layout being used as an example, the total air is 24,000 cu. ft. per minute; allowing an additional 10% for losses in the system it is found from the chart that a No. 9 Niagara Conoidal fan is the proper size and that this fan has an outlet area of 11.81 sq. ft. The duct leaving the fan should have an area equal to, or slightly greater than the outlet; assuming, in this case, a 46-in. diameter duct (area of 11.54 sq. ft.), all the other sizes are determined from this basic size, these being governed by the percentage of air handled in each case.

The percentage of air for each of sixteen equal outlets is 6¼% per outlet and this gives the percentages for each case as shown in Fig. 2. For instance, after the first pair of outlets is taken off the

Fig. 2.



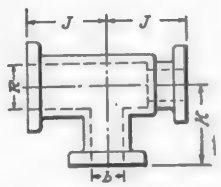
main duct, 87½% of the air is left; finding 87½ on bottom of chart and following this up to the point where it intersects with the curve the percent of diameter may be read in the left-hand column (95%) 46-in. x 95% = 43.7-in., or 44-in. diameter duct. To read the size directly, instead of going to the left from the intersection go to the right until the diagonal line for the original flue size (46-in.) is met. Vertically above this second intersection may be read the size of the flue which will carry 87½% of the volume at the same drop as the 46-in. diameter duct (or 44-in.) which agrees with the size obtained by the longer method of multiplying the 46-in. diameter by 95%.

Continuing this method for the other percentages gives the duct sizes shown in Fig. 2, from which the velocities (when desired) may be computed, these being in this case as indicated.

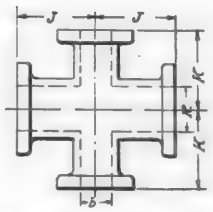
This gives a schedule of sizes as follows:—

Duct of Flue Mark	Quantity of Air C. F. M.	Proportion of Total P. C.	Diam. of Pipe Inches.	Area of Pipe Sq. Ft.	Velocity in Pipe F. P.M.
A	24,000	100	46	11.54	2080
B	21,000	87½	44	10.56	1980
C	18,000	75	41	9.17	1960
D	15,000	62½	38	7.87	1900
E-F	9,000	37½	32	5.58	1610
G	6,000	25	26	3.69	1620
H	3,000	12½	19	1.97	1520
J	6,000	25	26	3.69	1620
L	4,500	18¾	23	2.88	1560
N	3,000	12½	19	1.97	1520
K-M-O-P-Q	1,500	6¼	15	1.23	1220

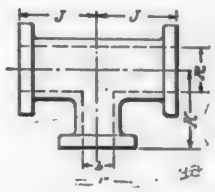
STANDARD BULL-HEAD REDUCING TEES AND CROSSES—FLANGED



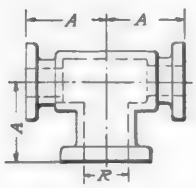
Reducing Tee.



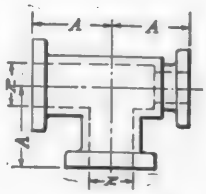
Reducing Cross.

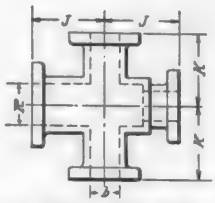


Reducing-on-Run Tee.



Bullhead Tee.





Reducing-on-Run and Branch Tee and Cross.

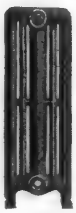
SIZE In. Diam. R	BRANCH "B"	DIMENSIONS, IN. A&J	K
1		3 3/4	3 3/4
1 1/4	1 or less	4	4
1 1/2	1 1/4 " "	4 1/2	4 1/2
2	1 1/2 " "	5	5
2 1/2	2 " "	5 1/2	5 1/2
3	2 1/2 " "	6	6
3 1/2	3 " "	6 1/2	6 1/2
4	3 1/2 " "	7	7
4 1/2	4 " "	7 1/2	7 1/2
5	4 1/2 " "	8	8
6	5 " "	8 1/2	8 1/2
7	6 " "	9	9
8	7 " "	10	10
9	8 " "	11	11
10	9 " "	12	12
12	10 " "	14	14
14	12 " "	14 1/2	14 1/2
15	14 " "	15	15
16	15 " "	16 1/2	16 1/2
18	18 to 14 inc.	18	18
20	20 to 15 inc.	20	20
22	22 to 16 inc.	22	22
24	24 to 18 inc.	23	23
26	26 to 20 inc.	24	24
28	28 to 20 inc.	25	25
30	30 to 22 inc.	26	26
32	32 to 22 inc.	27	27
34	34 to 24 inc.	28	28
36	36 to 26 inc.	29	29
38	38 to 26 inc.	30	30
40	40 to 28 inc.		

Note—A reduction in size *on the run* does not affect the dimensions but branch outlets of small size Such as are listed below will reduce the dimensions of fittings 18 in. or over in size.

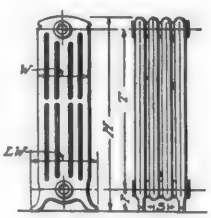
Branch "b"	J	K
12 or less	13	15 1/2
14 " "	14	17
15 " "	14	18
16 " "	15	19
18 " "	16	20
18 " "	16	21
20 " "	18	23
20 " "	18	24
22 " "	19	25
24 " "	20	26
24 " "	20	28
26 " "	22	29

FLANGES Diam. In.	Thickness In.
4	7/16
4 1/2	1/2
5	9/16
6	5/8
7	11/16
7 1/2	3/4
8 1/2	13/16
9	15/16
9 1/4	15/16
10	15/16
11	1
12 1/2	1 1/16
13 1/2	1 1/8
15	1 1/8
16	1 3/16
19	1 1/4
21	1 3/8
22 1/4	1 3/8
23 1/2	1 7/16
25	1 9/16
27 1/2	1 11/16
29 1/2	1 13/16
32	1 7/8
34 1/4	2
36 1/2	2 1/16
38 3/4	2 1/8
41 3/4	2 1/4
43 3/4	2 5/16
46	2 3/8
48 3/4	2 3/8
50 3/4	2 1/2

H. B. SMITH CO.'S PRINCESS FIVE-COLUMN RADIATORS FOR STEAM AND WATER.



Sections	Total Length ft.	Total Length in.	HEIGHT, INCHES 37 — 10 ft. per sec.	25 — 7 ft. per sec.	16 — 4½ ft. per sec.	14 — 4 ft. per sec.	12 — 3½ ft. per sec.
3	0	10⅝	30	21	14	12	10
4	1	2	40	28	18¾	16	13⅓
5	1	5⅓	50	35	23⅓	20	16⅔
6	1	8⅓	60	42	28	24	20
7	1	11⅓	70	49	32⅔	28	23⅓
8	2	3	80	56	37⅓	32	26⅔
9	2	6⅓	90	63	42	36	30
10	2	9⅓	100	70	46⅔	40	33⅓
11	3	⅔	110	77	51⅓	44	36⅔
12	3	4	120	84	56	48	40
13	3	7⅓	130	91	60⅔	52	43⅓
14	3	10⅔	140	98	65⅓	56	46⅔
15	4	1⅓	150	105	70	60	50
16	4	5	160	112	74⅔	64	53⅓
17	4	8⅓	170	119	79⅓	68	56⅔
18	4	11⅔	180	126	84	72	60
19	5	2⅔	190	133	88⅔	76	63⅓
20	5	6	200	140	93⅓	80	66⅔
21	5	9⅓	210	147	98	84	70
22	6	⅓	220	154	102⅔	88	73⅓
23	6	3⅔	230	161	107⅓	92	76⅔
24	6	7	240	168	112	96	80
25	6	10⅓	250	175	116⅔	100	83⅓
26	7	1⅓	260	182	121⅓	104	86⅔
27	7	4⅔	270	189	126	108	90
28	7	8	280	196	130⅔	112	93⅓
29	7	11⅓	290	203	135⅓	116	96⅔
30	8	2⅓	300	210	140	120	100



DIMENSIONS

H = Total overall height.
T = C. to C. of tappings.
F = Floor to center of bottom tapping.
W = Width of radiator—12 in.
LW = Width of radiator legs—12 in.
S = Width of radiator sections, i. e., C. to C. of sections—3 1/4 in.

Nominal Height of Radiator	37-in.	25-in.	16-in.	14-in.	12-in.
H	37	25	16	14	12
T	30 3/8	18 3/8	11	9	7
F	4 5/8	4 5/8	3	3	3

Note: For legless radiators deduct 3 in. from H for 37 in. and 25 in. heights and 1 in. for 16 in., 14 in., and 12 in. heights.
For extra high legs add 1 in., 2 in., 3 in., or 4 in., to H. and F.
On all radiators extra high legs are special.

TAPPING DATA

SYSTEM	Size of Radiator Square Feet	Supply In. Diam.	Return In. Diam.
Steam, one-pipe	Up to 30	1	.....
	Over 30 up to 60	1 1/4	.....
	Over 60 up to 120	1 1/2	.....
	Over 120.	2	.....
Steam, two-pipe	Up to 50	1	3/4
	Over 50 up to 120	1 1/4	1
	Over 120	1 1/2	1 1/4
Water	Up to 50	1	1
	Over 50 up to 120	1 1/4	1 1/4
	Over 20	1 1/2	1 1/2

All air valve tappings are 1/8 in., those for water radiators being set at top.
All tappings with R. H. threads unless otherwise ordered.

TRADE AND MISCELLANEOUS NOTES

Miscellaneous Notes.

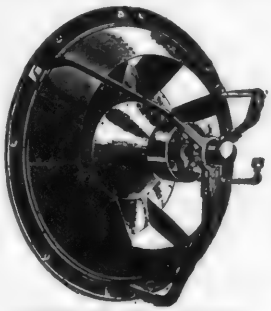
Chicago Commission on Ventilation, at its annual meeting July 9, elected the following officers: President, George Beaumont; vice-president, J. W. Shepherd; secretary, M. J. Sturm. The commission will hold its next meeting September 17.

Frank B. Rae, electrical and mechanical engineer, Cleveland, O., announces the removal of his office to Suite 219-220 Avenue Building, 46th St. and Euclid Avenue, Cleveland.

Chicago Master Steam Fitters' Association elected the following officers, at its annual meeting held June 25, at the Hotel Sherman: President, E. J. Claffey; vice-president, Harry M. Hart; secretary, Charles Glennon; treasurer, William Brady. Board of directors: the officers and William Benoit and George Hendricks. A testimonial was presented to retiring President Herlihy in the form of a diamond pin.

Brazil, Ind.—Earl Clevinger, president of the Hoosier Warming & Ventilating Co., of Muncie, Ind., was convicted by a jury in the Clay Circuit Court of the charge of bribing a township official. The specific charge was that he promised to pay Carl Biller, former trustee of Posey township, a draw back of $500 on a contract for repairing the heater of the Staunton High School. The amount of the contract was $1500. The case against Clevinger was founded on a confession made by Biller to the State Board of Accounts after irregularities had been found in his books.

Chicago, Ill.—Describing the surface car ventilators placed at the front and rear ends of the cars as "pneumonia boxes," a



DUPLEX CONE FAN
Belt Driven

HOWARD & MORSE
45 FULTON ST., N. Y.
Ventilating Engineers and Contractors
MANUFACTURERS OF
BLACKMAN and DUPLEX CONE FANS
which are installed by us complete with **Motors, Duct Work and Wiring.**

Aligning, Rigging and **Hoisting** done, with labor thoroughly qualified from long experience.

We make a specialty of **Kitchen Exhaust** work. Prominent buildings, hospitals, theatres, and private residences are among our many and recent installations.

The **Duplex Cone** Fans are semi-conoidal fans, made especially to operate against pressure in duct systems.

The **Blackman** Fans are used for fresh air delivery and in duct systems, when no great pressure is involved.

You can have the advantage of our experience.

SEND FOR CATALOGUE

BLACKMAN FAN
Direct Connected to Motor

writer in the *Chicago Post* declares that these openings which are designed to regulate themselves automatically do nothing more, in actual operation, than to send a draft of cold air down upon the floor of the car, keeping the temperature at the freezing point while heat is full on. The side ventilators, with which the cars are equipped, are approved.

Building Operations for June, 1918, show a curtailment of 27%, as compared with the figures for June, 1917. The reports from 143 cities, compiled by the *American Contractor, Chicago,* give totals of $45,255,067, as compared with $62,680,240 for the same month of last year. In New York City, the building operations fell off from $12,076,630 to $5,181,102. The figures for Chicago were $4,062,500, those for June, 1917, being $4,630,400. Detroit's decrease was 17%, from $3,679,145 to $3,917,975. Philadelphia dropped from $2,328,755 to $1,671,900. The following cities reported increases: Baltimore (from $380,436 to $959,732); Dayton (from $273,719 to $395,112); Hoboken (from $10,493 to $227,234); Kansas City (from $623,630 to $689,820); Lawrence, Mass. (from $50,005 to $428,868); Long Beach, Cal. (from $41,041 to $333,679); Lowell, Mass. (from $52,818 to $174,870); Milwaukee (from $684,920 to $755,797); Oakland, Cal. (from $362,382 to

ILG
SELF-COOLED MOTOR PROPELLER FANS

Can be used for...

COOLING
VENTILATING
DRYING
EXHAUSTING

2000 SELF-COOLED MOTOR PROPELLER FANS IN STOCK FOR QUICK SHIPMENTS.

"IF IT'S SELF-COOLED IT'S AN ILG"

ILG ELECTRIC VENTILATING CO.
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HIGH EFFICIENCY TRADE ILG MARK VENTILATING MACHINERY

DETROIT PACKLESS RADIATOR VALVES

The Correct Radiator Valve for Vapor Heating

The Detroit Packless Vacu Valve is a Graduated Valve for Vapor and Vacuum Systems of Heating. The dial plate is provided with a series of holes and a movable pin. This pin acts as a stop for the handle pointer and is inserted in the hole in the dial nearest the point at which the valve, when opened, admits only sufficient vapor or steam to fully supply the radiator.

DETROIT PACKLESS
Vacu Valve showing Dial Plate and Lever Handle

Booklet VP-1 Gladly Sent Upon Request

DETROIT LUBRICATOR COMPANY
DETROIT, U. S. A.

LARGEST MANUFACTURERS OF RADIATOR VALVES IN THE WORLD

$589,433); Pittsburgh (from $976,259 to $1,280,594); Seattle (from $371,260 to $1,023.525), and Tacoma (from $118,555 to $240,203).

Central Station Heating Notes.

Oskaloosa, Ia.—Extensions are being made by the Oskaloosa Traction & Light Company to the First Avenue East steam mains to form a tie line. The change is designed to relieve the pressure on the high school and give a more uniform service to patrons in that vicinity by furnishing two sources of supply instead of one, as before.

Waukegan, Ill.—The Public Service Company of Northern Illinois has filed a petition with the Public Utilities Commission to increase the rates charged consumers for steam heat in Evanston, Pontiac, Streator and Waukegan. The petition was filed June 14.

Springfield, Ill.—Strong objection is being expressed to the petition of the Central Illinois Public Service Company, of Mattoon, for an order permitting the company to discontinue its heating service in Virden and Carrollton. The same company has also applied for authority to abandon its heating utility in Charleston and White Hall.

Manufacturers' Notes.

Ilg Electrc & Ventilating Co., Chicago, Ill., has taken possession of twenty-three acres of land on Kenilworth Avenue, near Niles, which has been presented to the company by its president, Robert A. Ilg, for the use of the company's employees. The property will be improved and used as a recreation farm. Five cottages will be built at once. There will be an opportunity for gardening and the proceeds will be divided among the employees. The women and children will also be provided with means for recreation.

New Incorporations.

Magee Steam Specialty Corporation, New York, capital $50,000, to manufacture steam heating equipment. Incorporators: S. Solomon, J. Gallo and G. Goldstein, 4 West 103rd Street, New York.

Anderson-Brown Co., Flint, Mich., capi-

A Symbol and Its Significance

The JSC Symbol

It stands for the **Johnson Service Company,** the largest Heat Regulation Company in the World.

It is the largest because J S C System represents the highest development of heat control, because in the performance of its contracts J S C has always been accurate, prompt and conscientious.

The J S C symbol stands for satisfactory service always. It means that you, Mr. Engineer, and the Architect and the owner will get the best service at our disposal. Inquiries promptly answered. Offices in all principal cities.

The Johnson Service Co.
Milwaukee, Wis.

tal $60,000, to manufacture and deal in heating, plumbing and tinning supplies.

Gasteam Radiator Co., Oklahoma City, Okla., capital $25,000. Incorporators: H. R. Hoffman, F. E. Patterson and C. W. Hazleton, all of Oklahoma City.

Fred K. Wells Co., Boston, capital $10,000, to deal in hot water heaters and other devices. President and treasurer, Fred K. Wells of Winthrop; directors, E. E. Mackirnan and R. W. Light.

Contracts Awarded.

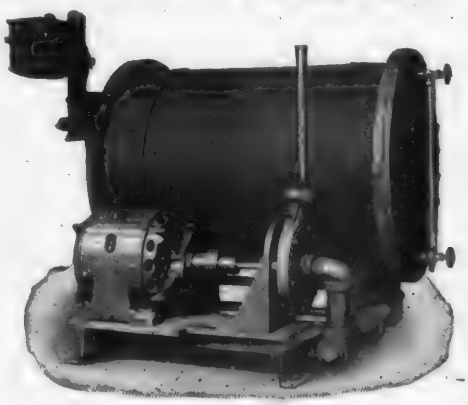
Linehan & Molo, Dubuque, Ia., have the contract for the heating and plumbing equipment for the new heating plant to be erected in Eldora, to heat the county buildings at that point. The plant will cost $15,000 and the heating and plumbing contracts amount to $5,850.

J. J. Ryan, Davenport, Ia., heating, plumbing, vacuum cleaning and ice water systems for the new Fort Des Moines Hotel, at Des Moines. The new hotel will have 300 rooms.

Mehring & Hanson Chicago, heating

WAR-TIME ECONOMY

demands the use of fuel-saving devices



ARCHITECTS AND ENGINEERS designing new plants generally provide for economical equipment, but there are many existing low pressure steam heating plants where a surprising amount of fuel could be saved by the installation of

Yeomans Electrically Operated Condensation Return Pumps

Made in Horizontal and Vertical Types for automatic operation

Send for Bulletin C-5000. Agents in all principal cities.

YEOMANS BROTHERS CO.
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Johns-Manville Radiator Trap

THE EXACT cost of material and labor plus a definite profit for you—that is your bid on a trap installation job when you use Johns-Manville Traps. There is no guesswork to it.

We give you the price you are rightly entitled to and the simplicity of the trap insures you a profit on the installation.

This Johns-Manville Trap is installed in record time—and once installed, you are through—no callbacks for adjustments or repairs. This trap doesn't jam, stick or airbind—it works. Ask any Johns-Manville salesman to show you one.

H. W. JOHNS-MANVILLE CO.
New York City
10 Factories—Branches in 61 Large Cities

the new $6,500,000 plant to be built by the Symington Chicago Corporation for the manufacture of artillery shells. It will be located at Seventy-fourth Street and Ashland Avenue. The main building will be 2200 ft. long. The parent company is now making shells and French 75's at Rochester, N. Y.

Business Changes.

Washington, Ia.—The Wilson Heating Co., of Washington, and J. H. Fenton, of Cedar Rapids, have combined their interests. Both Mr. Wilson and Mr. Fenton are past presidents of the Iowa State Master Plumbers' Association. Under the new arrangement Mr. Wilson will devote his attention to the contracting and sales end of the business, while Mr. Fenton will have charge of the installation work. The Wilson Heating Company has built up a thriving business in southeastern Iowa. The headquarters of the firm will be in Washington.

War Housing Activities.

Full charge of the housing problem has been vested in the Secretary of Labor, under the Overman Act, by the President in an executive order issued June 18. Work will be begun immediately on the various projects which have been under consideration by the bureau of industrial housing and transportation of the department. This bureau, of which Otto M. Eidlitz was appointed director in March by Secretary Wilson, will be in charge of the administration of the appropriation of $60,000,000, $10,000,000 of which is for housing within the District of Columbia.

Mr. Eidlitz states that the bureau is making investigations and will be ready to make developments in the following

Braemer
Air Conditioning Corporation
Air Purifying—Air Cooling—Humidifying—Dehumidifying—Industrial Ventilation—High and Low Temperature Drying—Generator Coolers—Dust Removal—Reclamation.
Webster Air Washers
LAFAYETTE BLDG.
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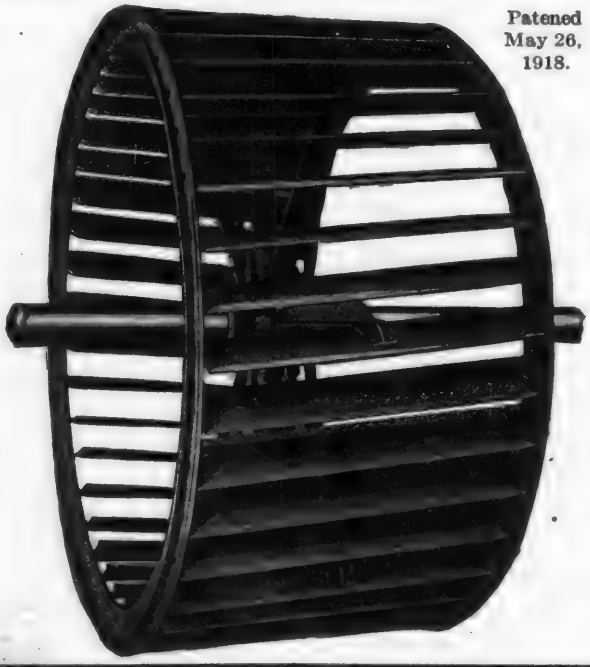
THIS IS WHAT WE HAVE BEEN "BLOWING" ABOUT!
THE NEW IMPROVED Cycloidal Multivane Wheel



Patened May 26, 1918.

For Heating and Ventilating

The vanes are curved forward, and set at an angle to the shaft, (patented feature) allowing uniform, unrestricted flow of air across entire width of wheel.

Highest Efficiency

Noiseless and Durable

Write for further details

Garden City Fan Co.
Est. 1879
CHICAGO, ILL.
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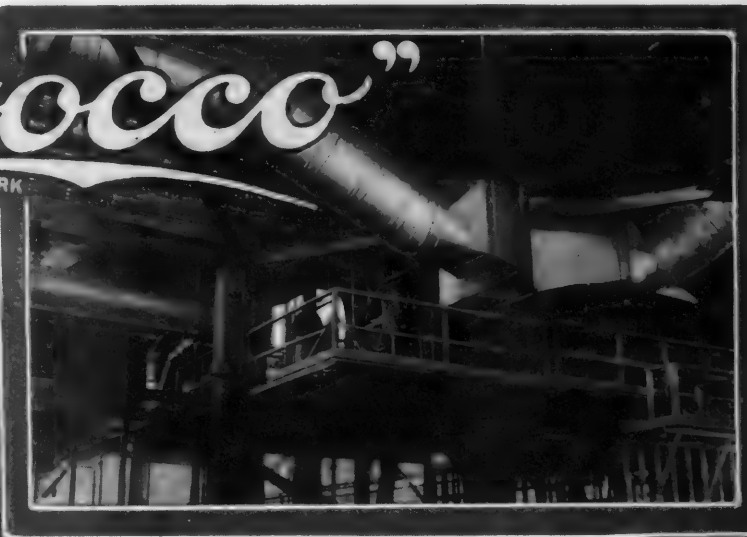
"Sirocco"

TRADE MARK



Speeds Up Production

In these days of rush work, with everything strained to the limit, fresh pure air for the factory is of vital importance.

The Sirocco System of Heating and Ventilating is used by many of America's best known and most successful manufacturers.

The view above shows an installation in a factory noted for its production and efficiency methods.

In the "dog days" of summer the Sirocco System is invaluable in keeping the factory workers fresh and fit by supplying the proper amount of fresh, pure air to every nook and corner.

Let us tell you more about Sirocco for your factory—Ask for Bulletin No. 270.

American Blower Company

DETROIT, MICHIGAN

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places: Bath, Me.; Bethlehem, Pa.; Bridgeport, Conn.; Charleston, W. Va.; Erie, Pa.; Norfolk, Va.; Portsmouth, Va.; Portsmouth, N. H.; Rock Island, Moline, East Moline, Ill.; Davenport, Iowa; Quincy, Mass.; Watertown, N. Y.; Indianhead, Md.. New Brunswick, N. J.; New London, Conn.; Mare Island, Cal.; Philadelphia, Pa.; Puget Sound, Wash.; Niagara Falls, N. Y.; Alliance, Ohio; Hammond, Ind.; Sharon, Pa.; Niles, Warren, Ohio; Lowell, Mass.; Aberdeen, Md.; Newport, R. I.

Metropolitan Industrial Commission Organized.

In line with the plans of the War Trade Board for the organization of industrial commissions throughout the country, based on that formed for the Cleveland district, a regional industrial commission for the New York metropolitan industrial zone has been formed through the efforts of the Merchants' Association of New York. An outline of the general plan, which includes the division of the country into business "regions" was given in last month's issue. It is hoped eventually to have a national organization of manufacturers similar to the United States Chamber of Commerce, but confined to the manufacturers of the country.

Proposed New War Taxes.

Heavy increases in war taxes, with an excess-profits tax as high as 80%, are proposed by a special committee on financing the war, of the United States Chamber of Commerce. The report presents eleven specific recommendations:

That exemptions allowed before war taxes are imposed should be adequate for the safe conduct of business enterprises.

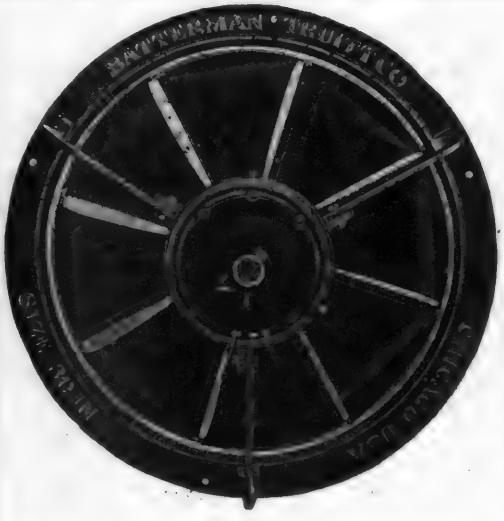
That liberal provisions be made for amortization of plant used upon war work.

That there should be a limited number of regional boards of review to make recommendations upon appeals from preliminary assessments.

That there should be equalization of federal taxes.

That in computing taxable income, corporations should be allowed to make two deductions (interest and charitable gifts) which they are now denied.

On condition that proper exemptions and



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Motor Driven Propeller Fans

The very latest ideas on improved propeller fan construction are embodied in the wonderful mechanical perfection of these fans. The motors are of the protected type, provision being made for easy accessibility and inspection of working parts within motor by removal of end hood cover. The motor windings are protected against dirt, grease, acids, or other foreign substances from entering therein.

Patent Rotor-Centering bronze bearings are used on all multi-phase fan motors 36" size and above, the rotor and shaft can be re-centered by one-half turn of outer bushing without removing the motor end hood; also shafts have exceptionally large diameters.

All sizes carried in stock for quick shipments

Easiest to Install **Neatest in Appearance** **Quietness of Operation**

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HEATING SYSTEMS

are not an experiment. They are giving satisfactory use in hundreds of installations.

The Ideal Unit Heating System

ECONOMICAL and SIMPLE

We welcome the fullest investigations of our claims and records of many years' service

Send for latest catalogues containing photographs of typical installations in various types of buildings

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NEWARK - NEW JERSEY - U. S. A.

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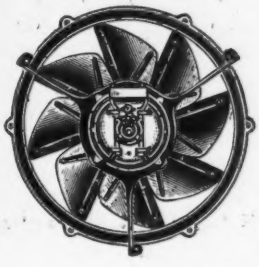
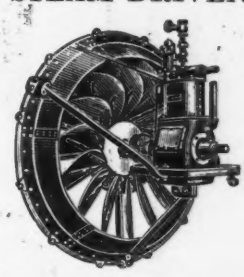
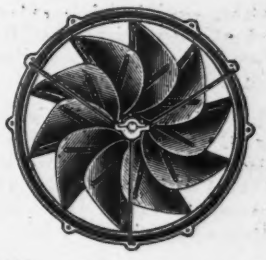


STEAM DRIVEN



BELT DRIVEN



Send for Bulletin No. 121, Jan. 1917

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Ventilating systems to suit all conditions. **Dust Collectors, Humidifiers, Dry-Rooms** to dry anything from bricks to sponges.

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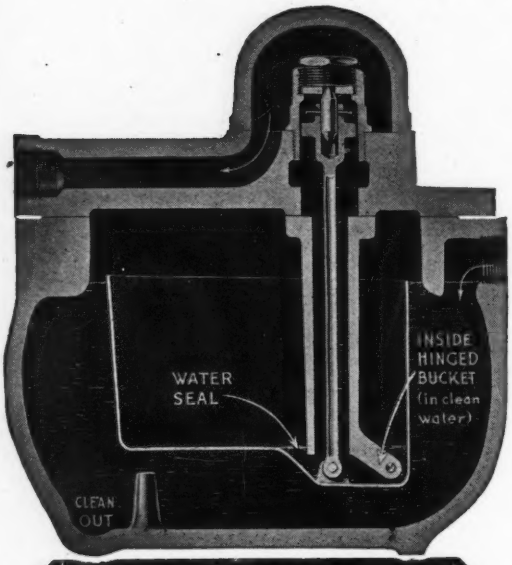

Catching Dollars with a Trap

THE SWARTWOUT

Hydromatic Trap

will catch and save the dollars that would otherwise go to waste.

When coal is high-priced and hard to get at any price, the little, over-looked wastes of our former "easy-going" days must be stopped.

The Swartwout Hydromatic Trap will positively prevent any waste of steam at your heaters or steam lines. Its action is certain—effectual. It prevents that wasteful drizzle that is constantly nibbling at your coal pile.

Swartwout Hydromatic Traps will pay big dividends—in many cases they have paid for themselves in one month.

Write today and find out how they will help you to conserve coal. Full information and catalog—free.

The Ohio Blower Co.

9211 Detroit Ave. Cleveland, Ohio.

opportunities for adjustment are allowed," that a war-profits tax should be imposed at a high rate and should be levied when it would exceed the excess-profits tax.

That upon the present general basis, but with inequalities removed, the excess-profits tax should be increased.

That rates of income taxes should be increased and unearned incomes taxed at least as much as earned.

Heavy taxes upon a few articles of widespread consumption and upon a selected list of luxuries, as well as upon a selected list of war extravagances.

The New Era for the Engineer.

The man of the future will be the engineer.

He is the man who can do things; and is better than the man who owns things.

Some day little boys will read that the world once had millionaires and huge private wealth units, just as they will one day read and wonder that men once had kings.

But the official who will forever be indispensable is the engineer.

The time will come when the President

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Steam, Vacuum Compound, Altitude, etc.

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It is more than a catalog —it is a text book on Instruments for Indicating and Reading Pressure, Vacuum Draft, Temperature, etc.

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"COLUMBIA"

Also many other Allied Instruments, Gauge Boards and Complete Equipment

Specify Buffalo

ONE of the important items of every building about to be constructed is the heating system.

Obviously to give the client the most for his money is the first consideration.

It is comparatively simple to install a heating system but it is another matter to make it always efficient.

Buffalo Fan Systems are no higher in first cost and their upkeep is offset by the saving in heat, the increase in efficiency of the workers.

Putting heat mechanically just where it is wanted by keeping it in circulation instead of letting it escape through the ventilation in the roof, is the cheapest and best way.

Catalog No. 198 gives valuable engineering data on heating and ventilating problems. Our engineering department is always available for consultation.

Write Dept. 36.

BUFFALO FORGE COMPANY
Buffalo, N. Y.

Inefficient Heating Systems in Old Buildings can be Remodeled at Comparatively Small Cost into Efficient WEBSTER Systems

NOW is the time to act in order to derive full benefit and economy for adequately heating buildings next winter, without carrying several pounds back pressure on the engines or using an undue amount of live steam.

From present indications, there will be a great scarcity of coal during the coming cold months. Prepare NOW to overcome this by installing the WEBSTER System.

At comparatively small cost and without extensive alterations or seriously impairing the operation of any department—the unsatisfactory heating system can be changed over in a short time into the efficient

Webster

Vacuum System of Steam Heating

Over 11,000 successful installations in all classes of buildings during the past 30 years. A large part of these were changed over from old heating systems. A return of from 25 to 50 per cent has often been realized on the investment required for changing over a poorly designed heating system into the efficient WEBSTER System.

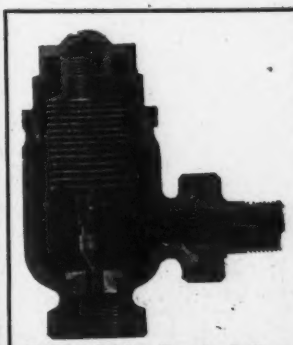
The WEBSTER System provides perfect circulation of exhaust steam, live steam or a combination of the two through every radiator or pipe coil without appreciable back pressure on the engine, or noise, odor, air binding and other objectionable features.

We co-operate with the architect, consulting engineer, heating contractor or owner to help secure the best and most economical results at the least possible cost.

The Webster Guarantee is the Owner's Insurance Policy

Write TODAY for a copy of our Catalog V-37
Heating the Manufacturing Plant by the Webster System

WARREN WEBSTER & COMPANY



Webster Sylphon Trap for Radiator Returns and at Drip Points

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Branch Offices in 30 Cities

Fuel Conservation Specialists for Thirty Years

of the United States will be chosen as the man who has the greatest talent and skill in organizing public works.

There will be no more politics in his selection than there is now in choosing the master mechanic of a railway or factory.

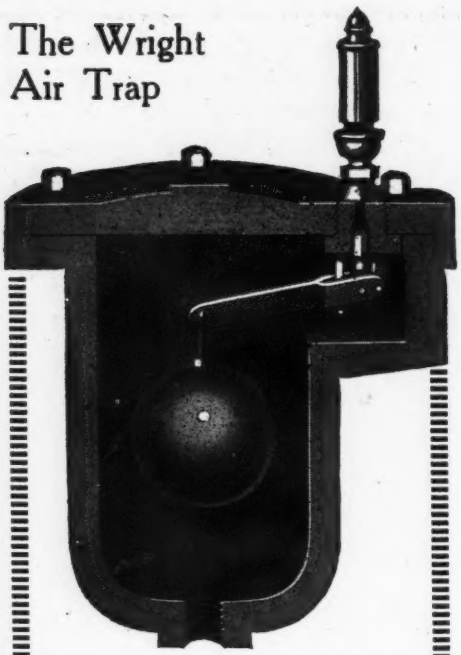
We need the engineer to arrange the transportation of people and goods from place to place without waste, without competition, without graft, looking only to the public good.

We need the engineer to manage a city as economically and smoothly as if it were a manufacturing plant.

Wealth can be taken away from us. But the power to do things cannot be taken away.

The millionaires could go and not be missed. The engineers we cannot spare.—Dr. Frank Crane, in the Associated Newspapers.

The Wright Air Trap



Removes Air from Water Under Pressure

This Trap is designed for removing air from water under pressure, for which purpose it is without an equal. It has large capacity, is positive in action and simple in construction. The float is round and seamless. When used in hot water heating systems, the Trap is placed at the highest points. It can be placed in street manholes, requiring no attention whatever.

Other purposes of this Trap are for removing the air from closed water receivers, and for sounding an alarm when the water in closed tanks reaches a lower point than is desired. For the latter service the Trap is equipped with a whistle.

Among a variety of services to which it is adapted is the discharge of air from closed water receivers.

Size of Trap, 6 x 7; inlet, ¾ in.

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Detroit, U. S. A.

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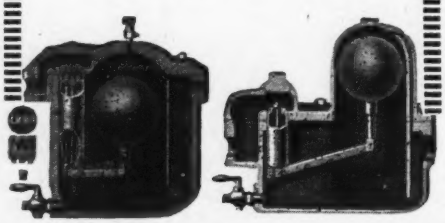

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